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AIRBORNE RADIATION THERMOMETER MEASUREMENTS FROM CAPE COD, MASS--ETC(U)
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AIRBORNE RADIATION
THERMOMETER MEASUREMENTS
FROM
CAPE COD, MASSACHUSETTS
TO
MIAMI, FLORIDA

July 1970 - June 1976

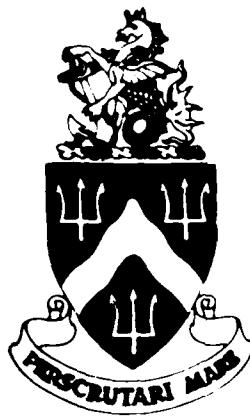


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The distribution of 9 species of marine animals as a function of latitude and SST are presented.			
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AIRBORNE RADIATION THERMOMETER MEASUREMENTS FROM CAPE COD, MASSACHUSETTS TO MIAMI, FLORIDA

July 1970 - June 1976

J. W. Deaver

J. C. Reed

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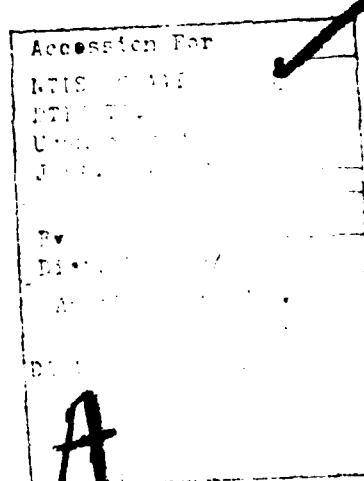
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ABSTRACT

Sea surface temperatures (SST) for the period of July 1970 to June 1976 from Cape Cod, Massachusetts to Miami, Florida were measured during the U.S. Coast Guard Oceanographic Unit's Airborne Radiation Thermometer (ART) monthly surveys. A total of 72 monthly SST contoured isotherm charts are presented which are constructed from data obtained on these surveys.

The distribution of 9 species of marine animals as a function of latitude and SST are presented.



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AIRBORNE RADIATION THERMOMETER MEASUREMENTS FROM CAPE COD, MASSACHUSETTS TO MIAMI, FLORIDA

JULY 1970—June 1976

By

J.W. Deaver
J.C. Reed

INTRODUCTION

Since July 1969, the U.S. Coast Guard Oceanographic Unit has been conducting monthly Airborne Radiation Thermometer (ART) surveys of the United States Atlantic Ocean coastal waters between Miami, Florida and Cape Cod, Massachusetts. The primary purpose of these over flights was to measure sea surface temperature (SST) distributions and observe visual current boundaries connected with the Gulf Stream for use in Search and Rescue (SAR) planning. This information along with marine animal sightings and pollution incidents were published monthly under the title of "Surface Isotherm Charts" by the Coast Guard Oceanographic Unit.

This report covers the period July 1970 to June 1976. The data were collected using operating procedures previously published (Deaver, 1975). Over 564,400 km of transects covering approximately $1.08 \times 10^7 \text{ km}^2$ of Atlantic Shelf and Slope Water and Gulf Stream were covered during the 7 years (Fig. 1).

From October 1974 to May 1975, no data were collected south of Cape Hatteras, North Carolina due to aircraft non-availability.

Surveys were normally scheduled for the middle of each month, however, surveys were sometimes delayed for periods of up to two weeks due to operational difficulties.

METHODS AND EQUIPMENT

A Barnes Engineering Company, Precision Radiation Thermometer (PRT-5) was used to

measure the SST during ART surveys. The PRT-5 has been modified to view through the 9.5 to 11.5 μ wavelength window which was the most desirable filter available for SST measurements (Weiss, 1971). The PRT-5 signal was recorded on a continuous analog strip chart. The strip chart recorder was calibrated by measuring the known temperature of a hot and cold water bath prior to and at the completion of a flight.

An extensive review of the methods and equipment used was presented previously in Deaver, (1975).

SURFACE TRUTH ADJUSTMENT

All ART surveys were flown at or below 150 meters to avoid adverse atmospheric attenuation (Henderson, 1976). Data collected during periods of rain, snow, fog or heavy haze were discarded.

Accuracy of the ART data using selective sampling methods mentioned above is within $\pm 0.6^\circ\text{C}$.

SEA SURFACE TEMPERATURE CHARTS

Monthly sea surface temperature charts for Atlantic Ocean coastal water from Cape Cod to Miami are presented in 72 charts (Figs. 2-73).

Contour charts were constructed utilizing temperature measurements along survey transects. Contour shapes between transect crossings were based on subjective interpretation and additional data from satellite and shipboard observations.

MARINE ANIMAL OBSERVATIONS

Sightings of nine types of marine animals observed on ART surveys have been recorded for the period July 1970 to June 1976 from Miami, Florida to Cape Cod, Massachusetts. These data are presented as a seven year weighted mean latitude and temperature value for each animal (Fig. 74). The formula utilized for this calculation was previously published (Deaver, 1975). These data

are presented only as a by-product of ART surveys for the benefit of the oceanographic community.

ACKNOWLEDGEMENT

The authors are indebted to the pilots and crews of the Coast Guard aircraft involved in the monthly ART surveys and especially to the Marine Science Technicians at the Coast Guard Oceanographic Unit who obtained these data.

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Weiss, M. (1971) Airborne Measurements of Earth Surface Temperature (Ocean and Land) in the 10-12 μ and 8-14 μ Regions. Applied Optics, Volume 10 No. 62 p. 1283, June 1971.

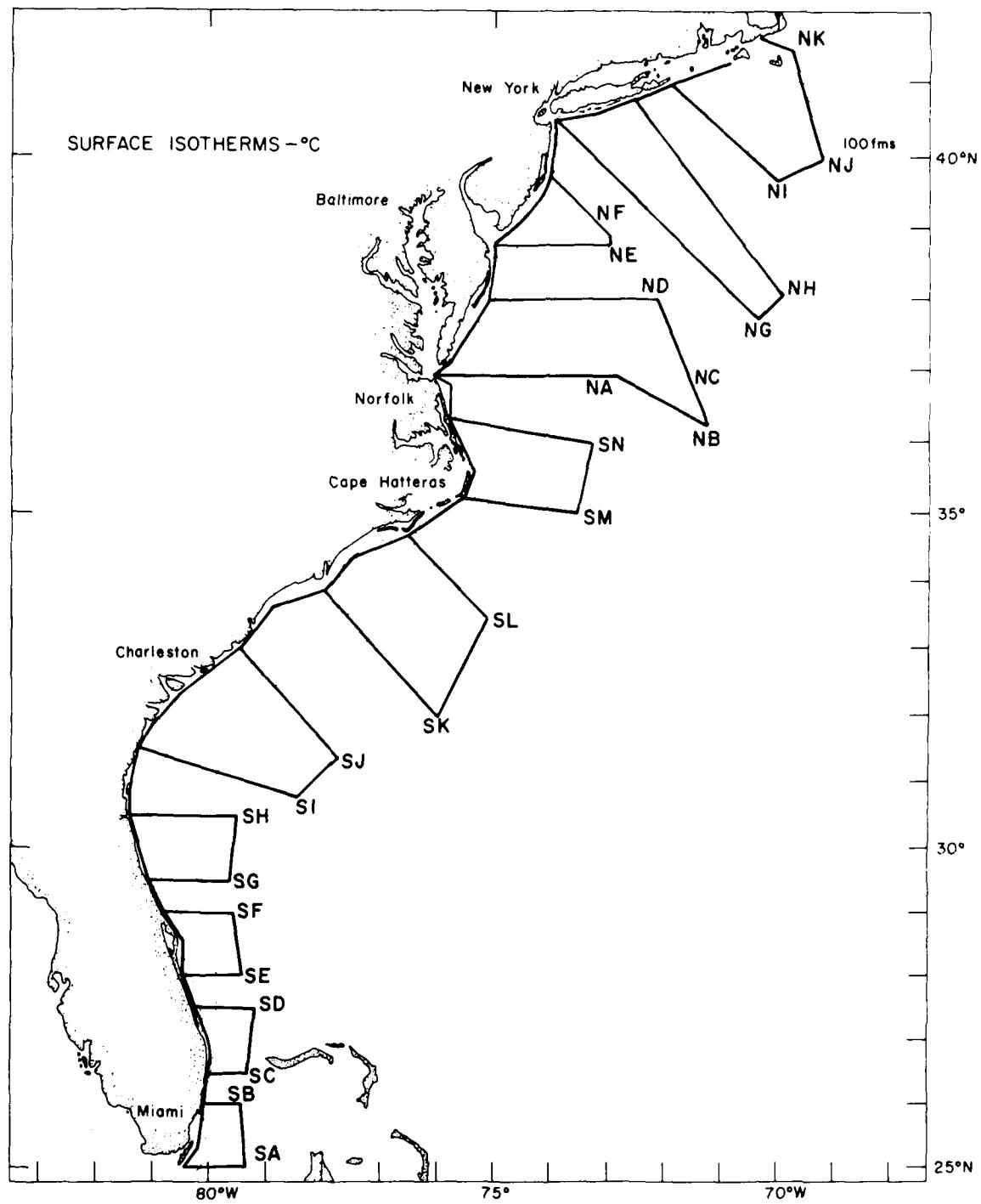


Figure 1. Standard ART flight trackline, July 1970-June 1976

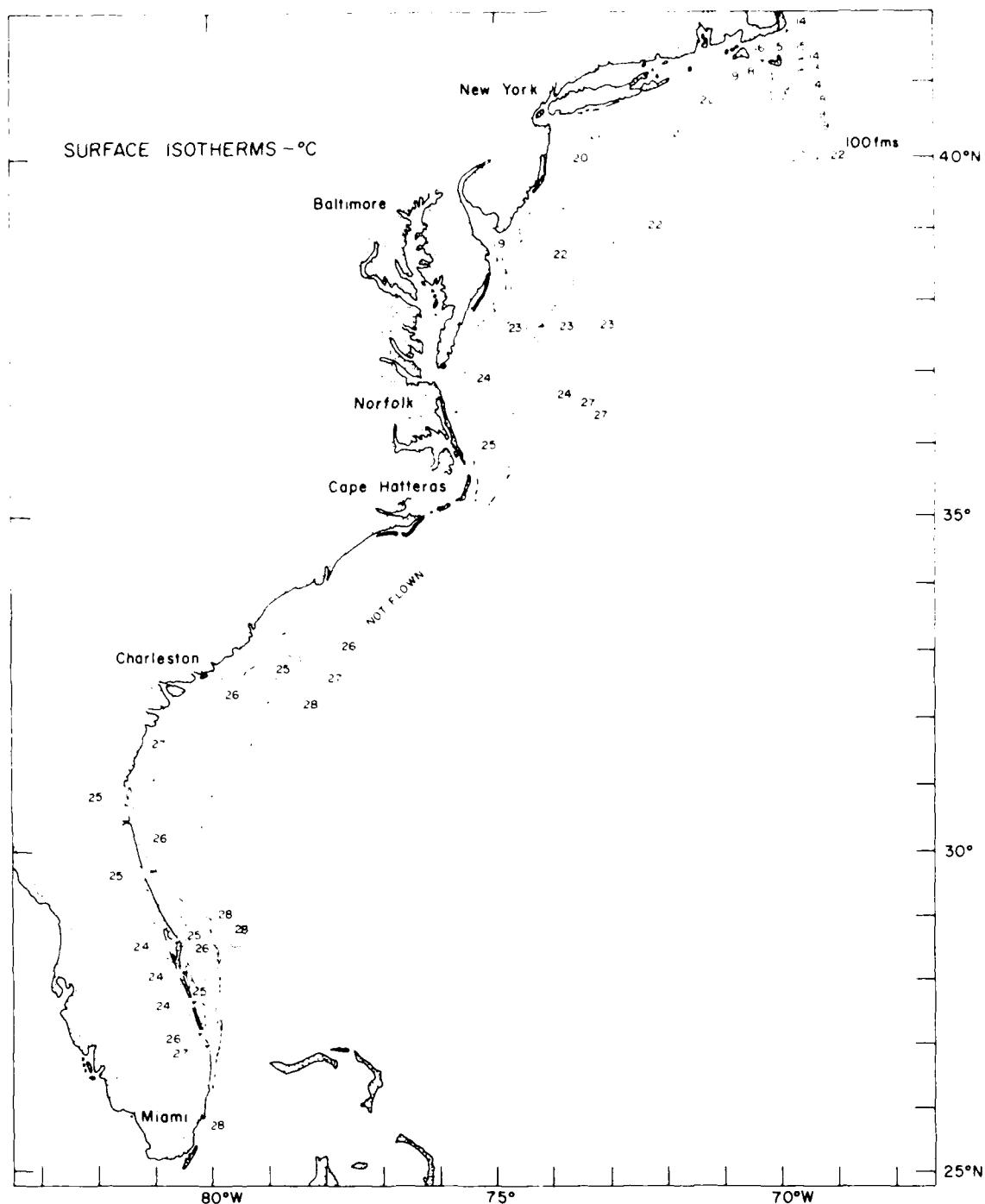


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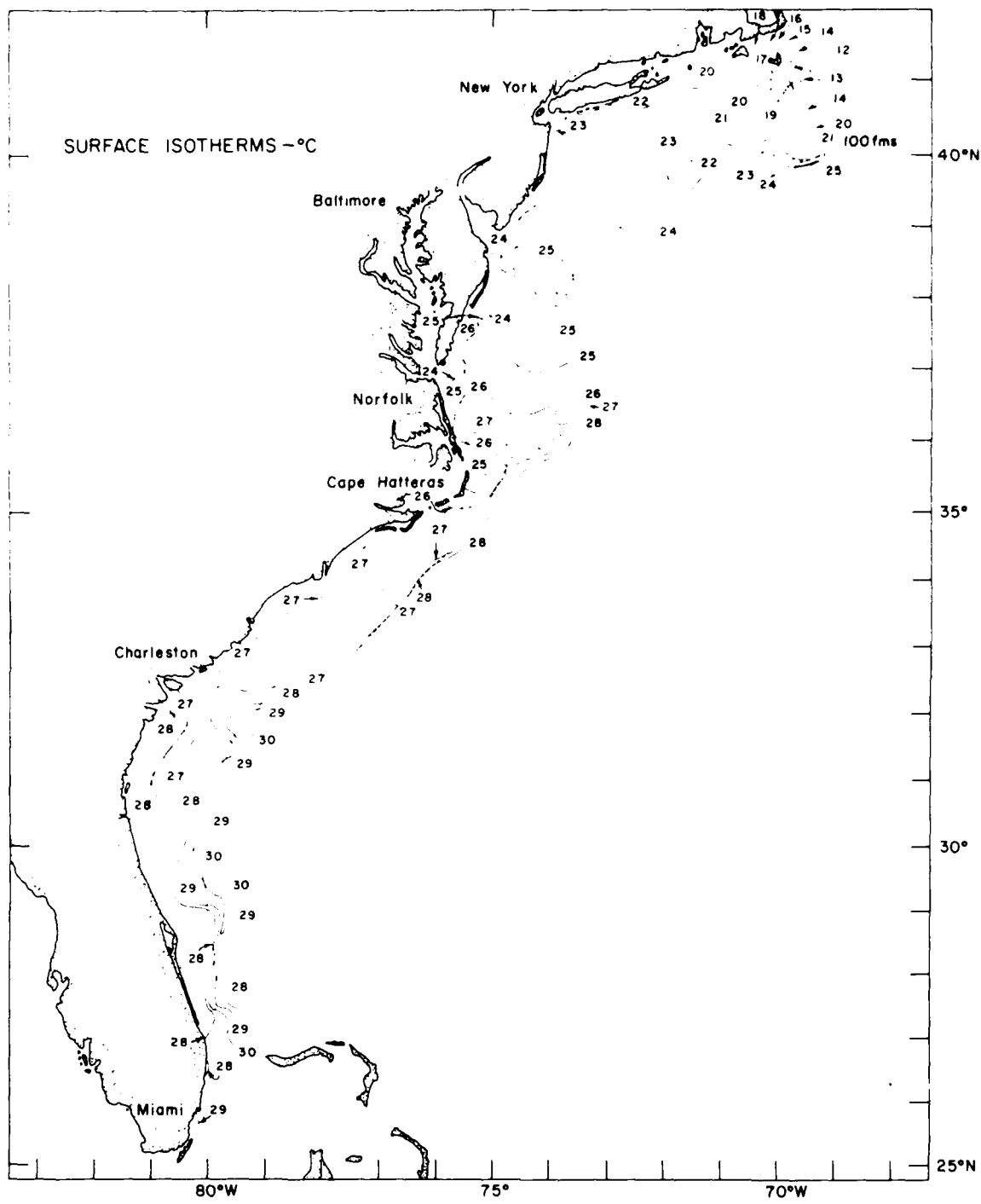


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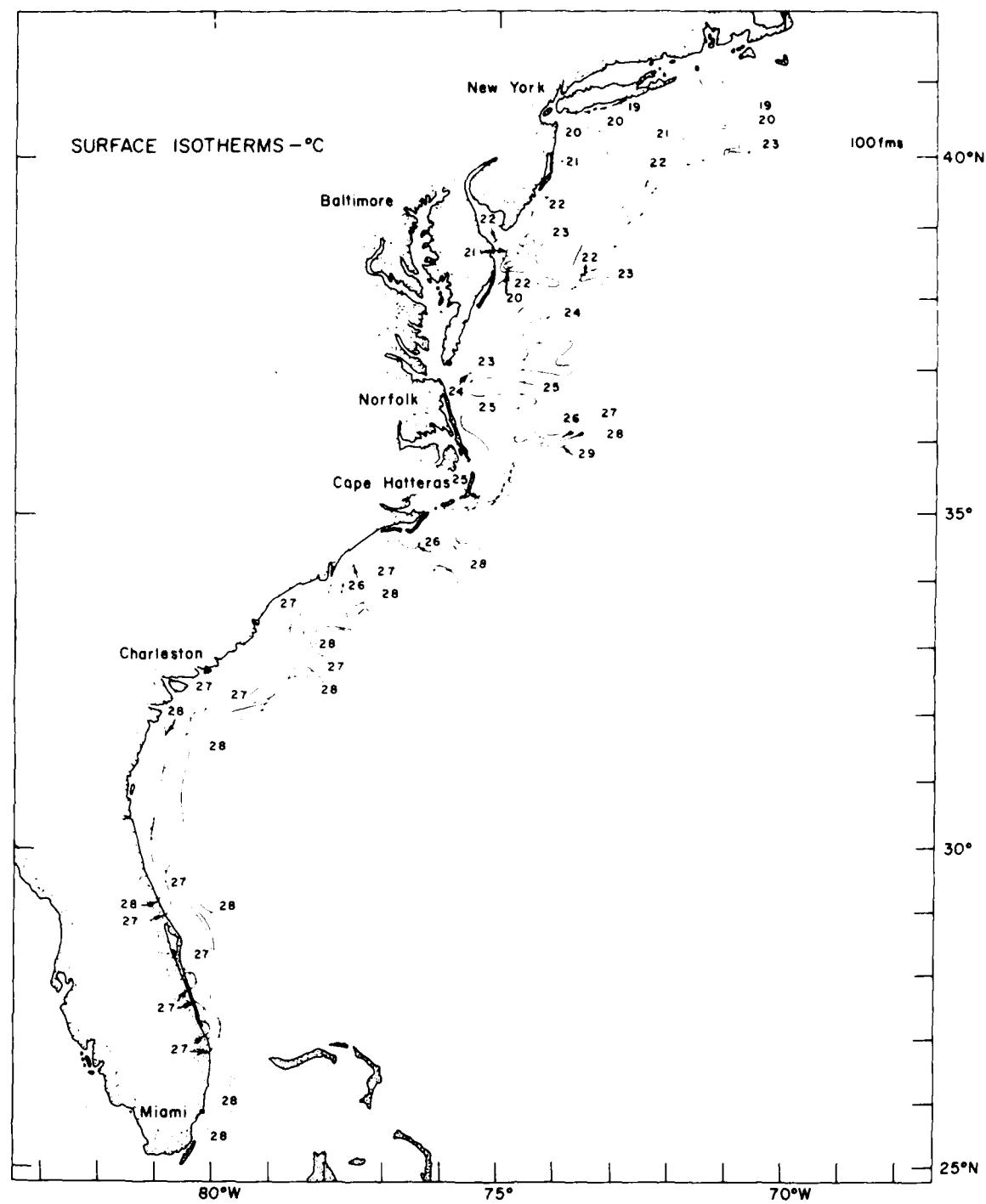


Figure 4. Monthly surface isotherm chart, 15-17 September 1970

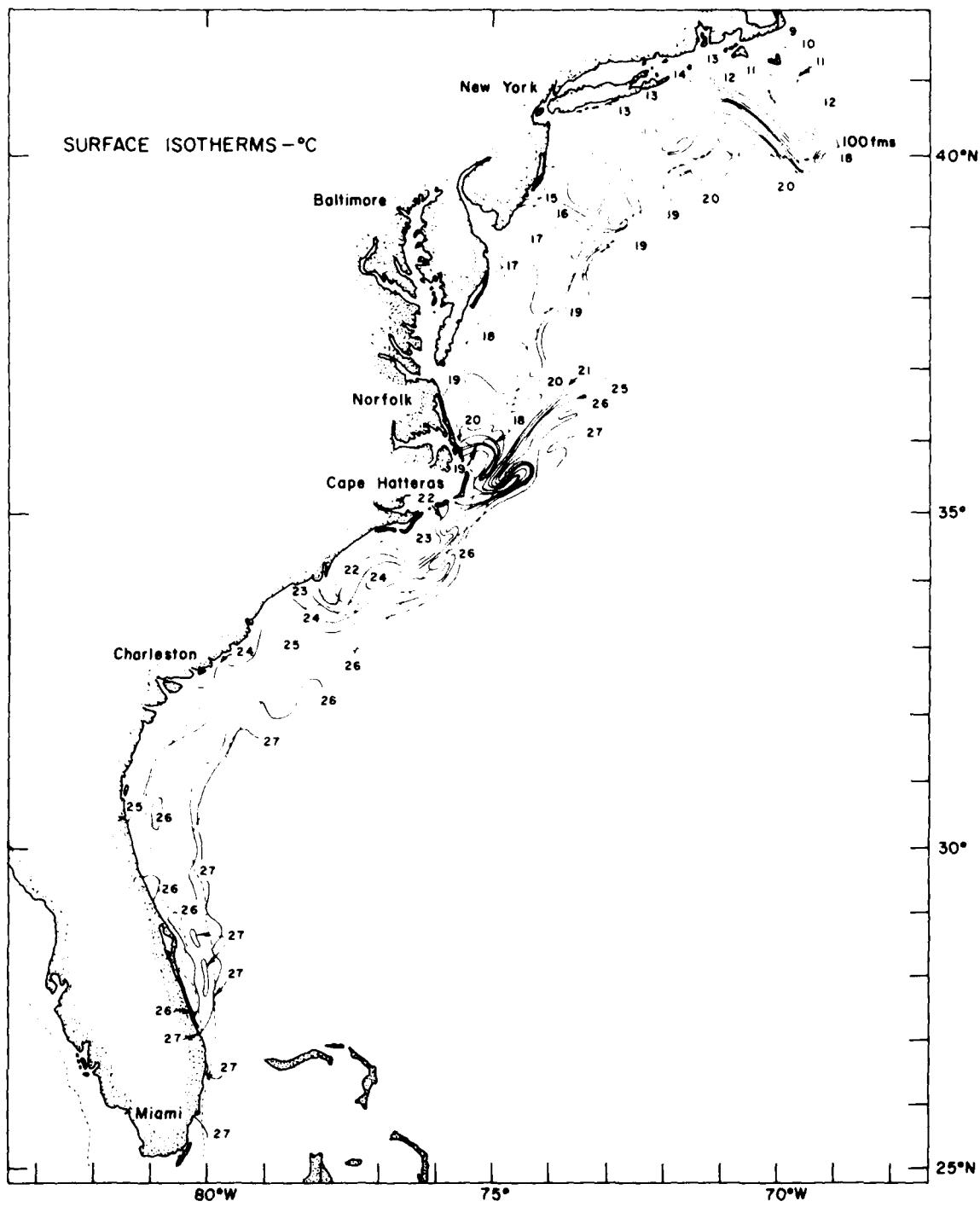


Figure 5. Monthly surface isotherm chart, 13-15, 20, 21, 27 October 1970

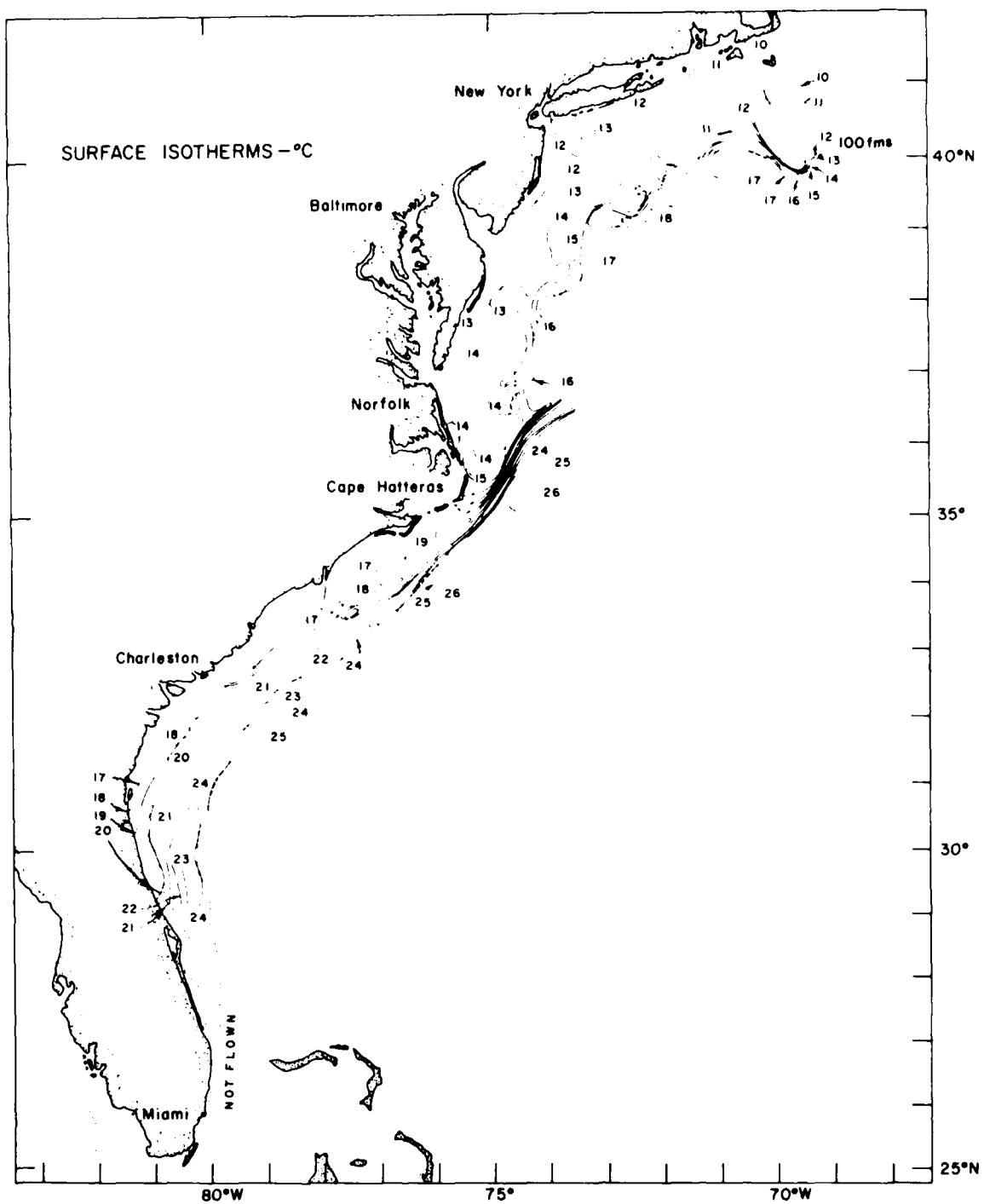


Figure 6. Monthly surface isotherm chart, 17-19, 23, November 1970

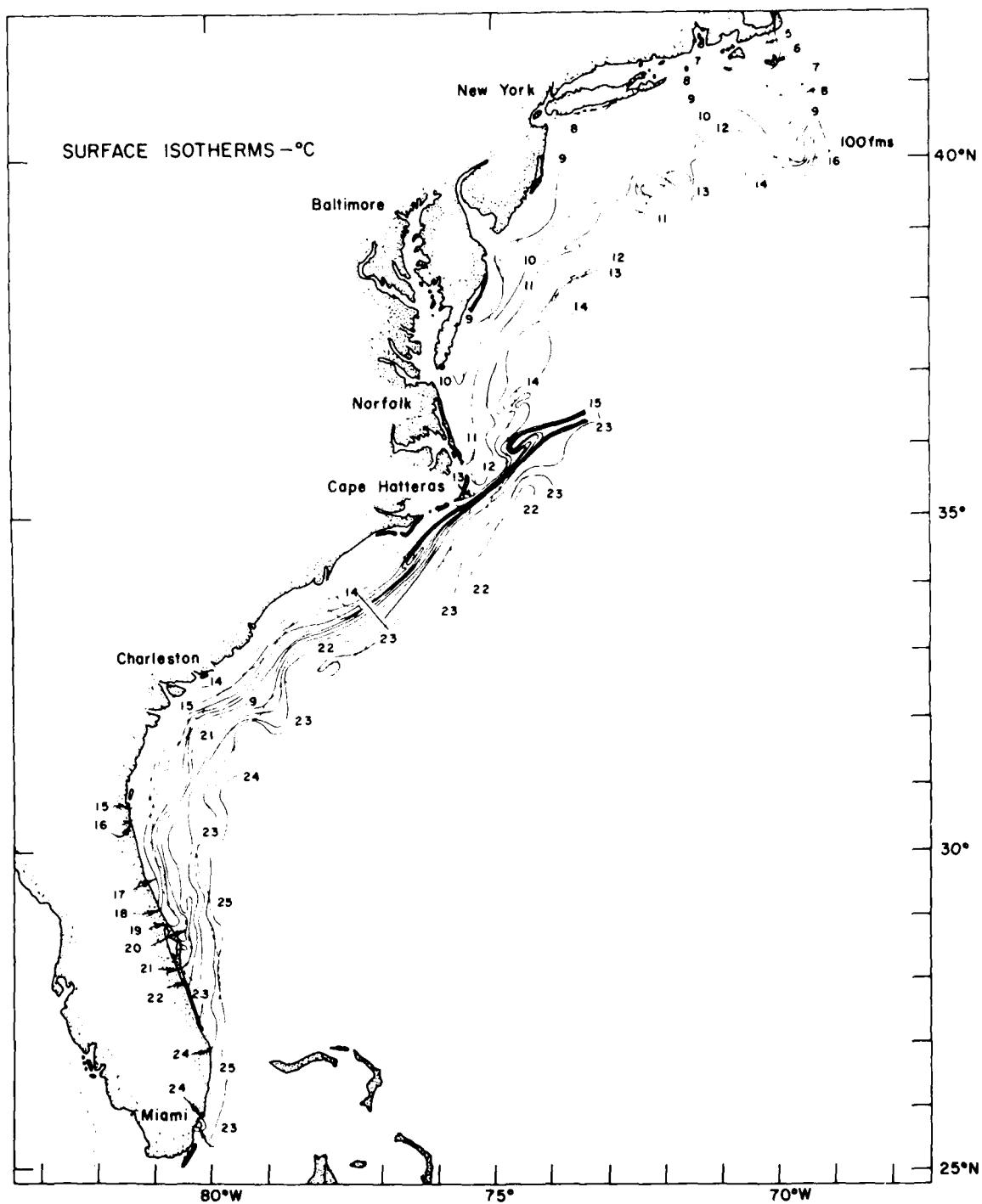


Figure 7. Monthly surface isotherm chart, 15-17, 18 December 1970

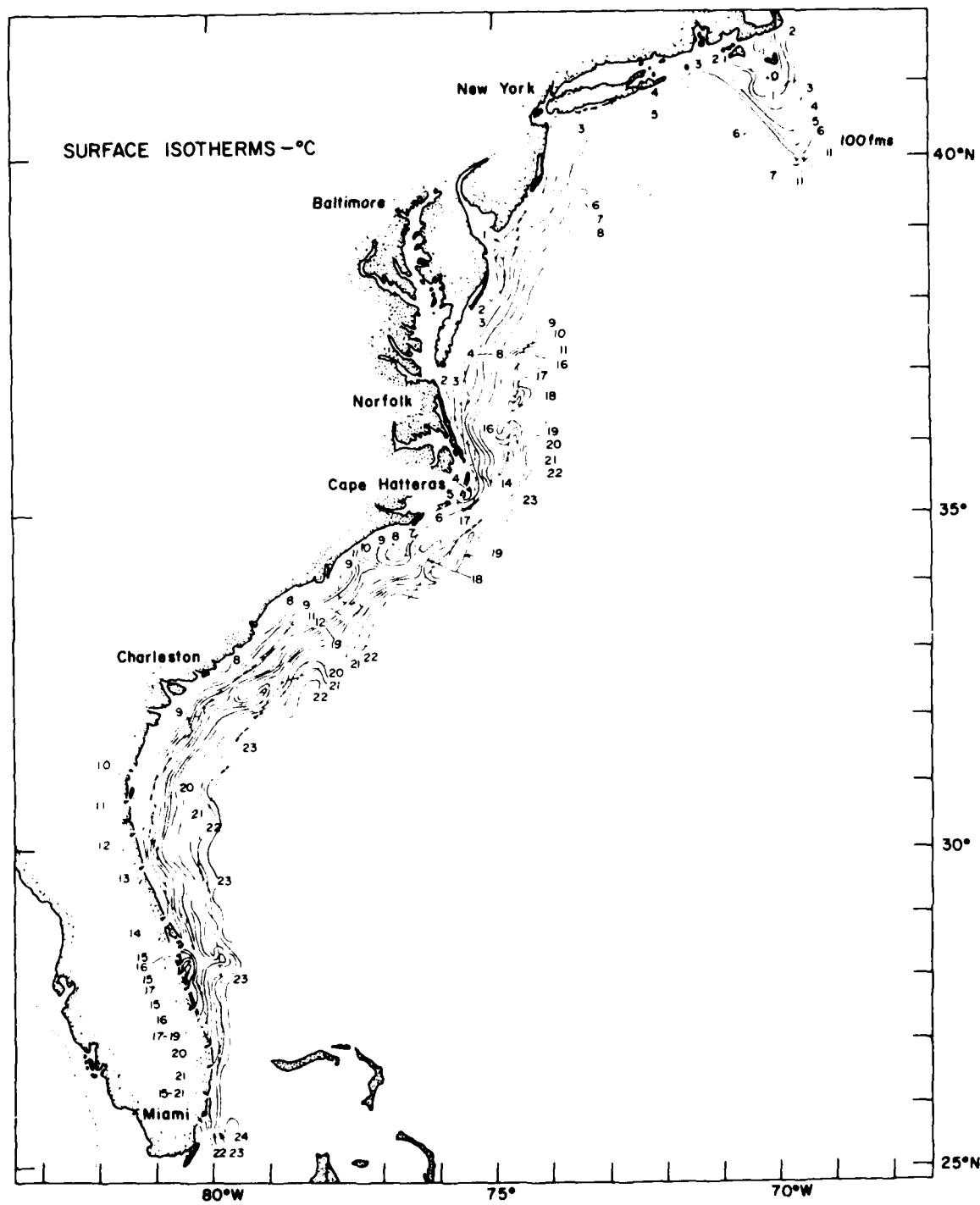


Figure 8. Monthly surface isotherm chart, 18-22 January 1971

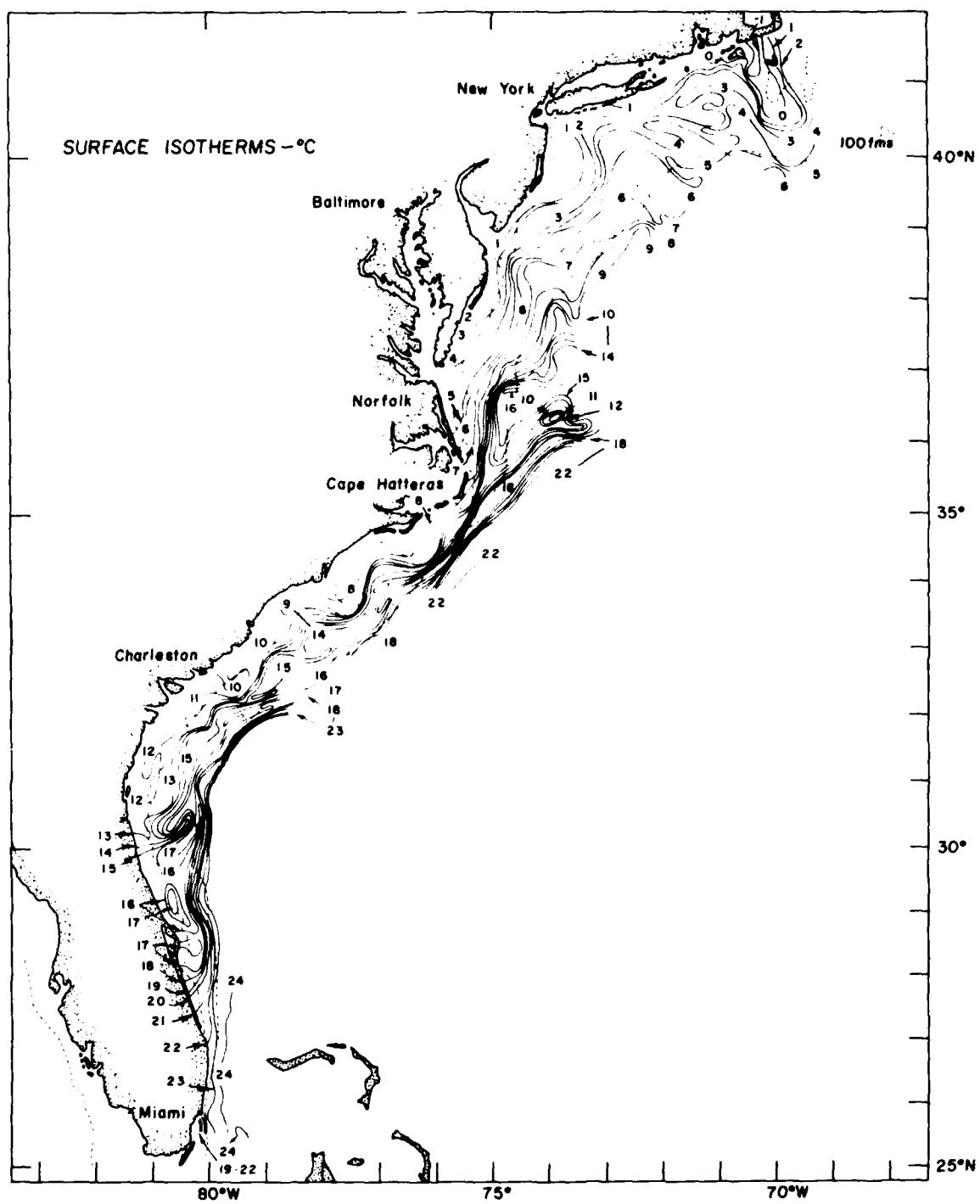


Figure 9. Monthly surface isotherm chart, 16-19 February 1971

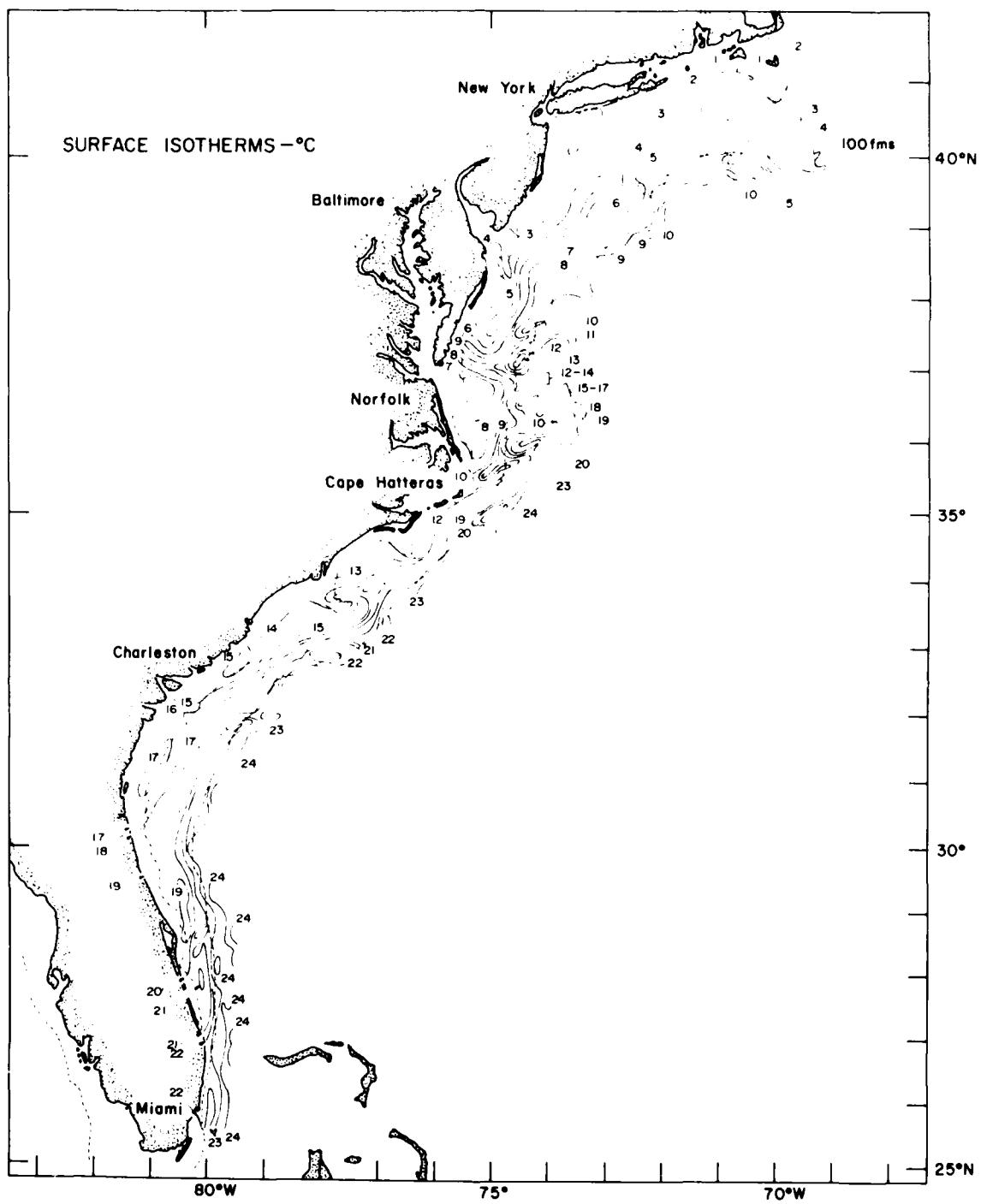


Figure 10. Monthly surface isotherm chart, 16-19 March 1971

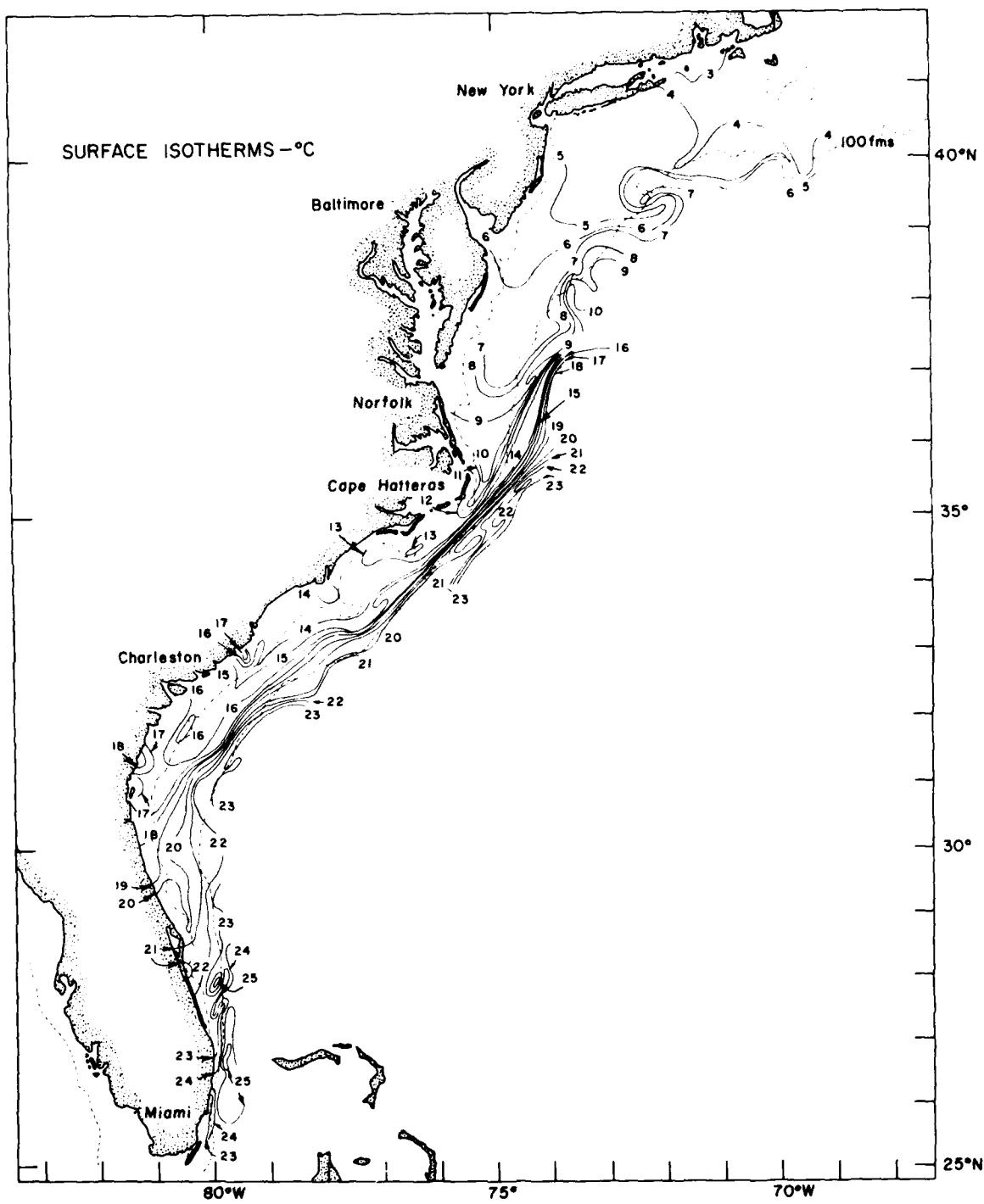


Figure 11. Monthly surface isotherm chart, 13-16, 19 April 1971

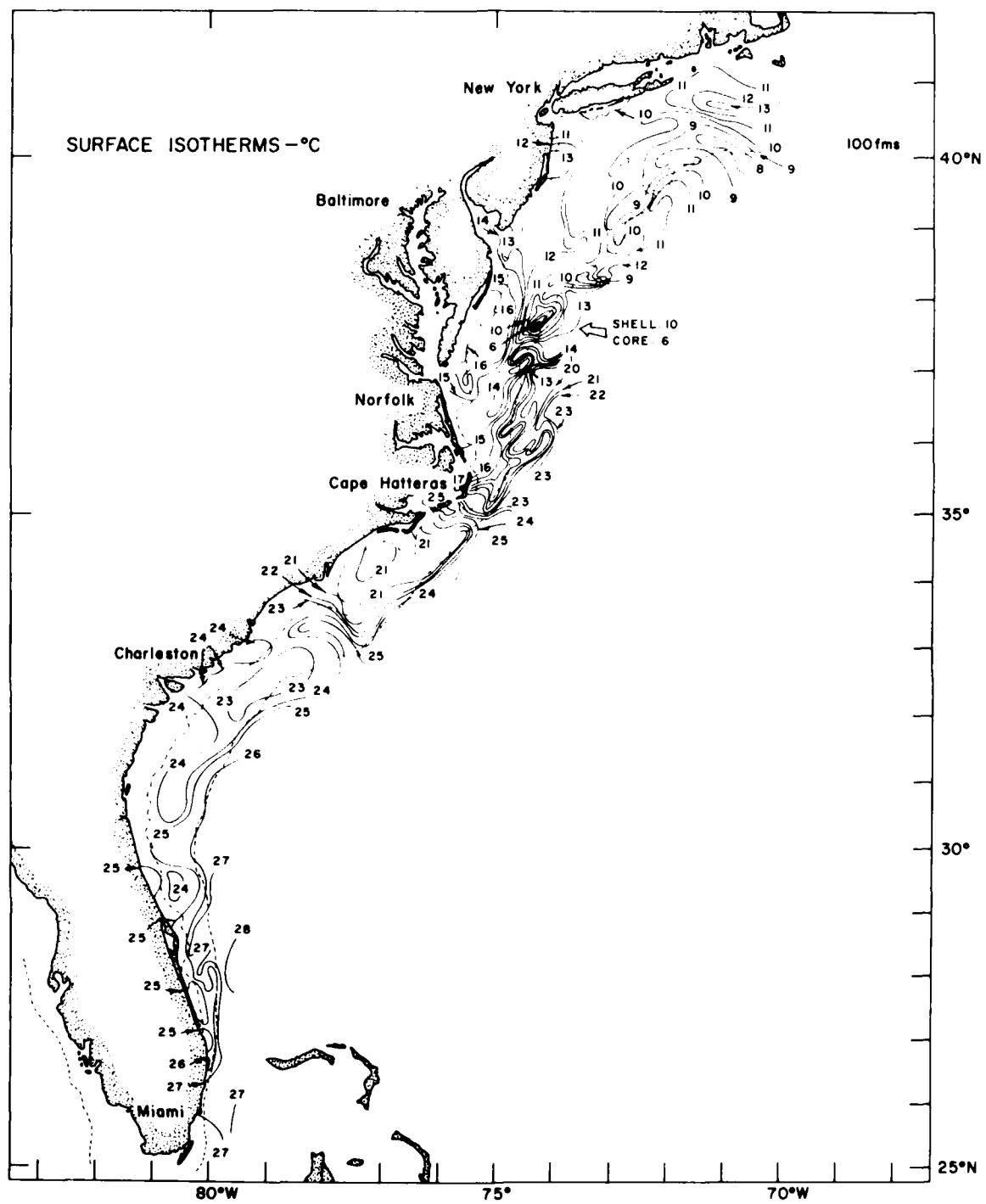


Figure 12. Monthly surface isotherm chart, 18-20, 22, May 1971

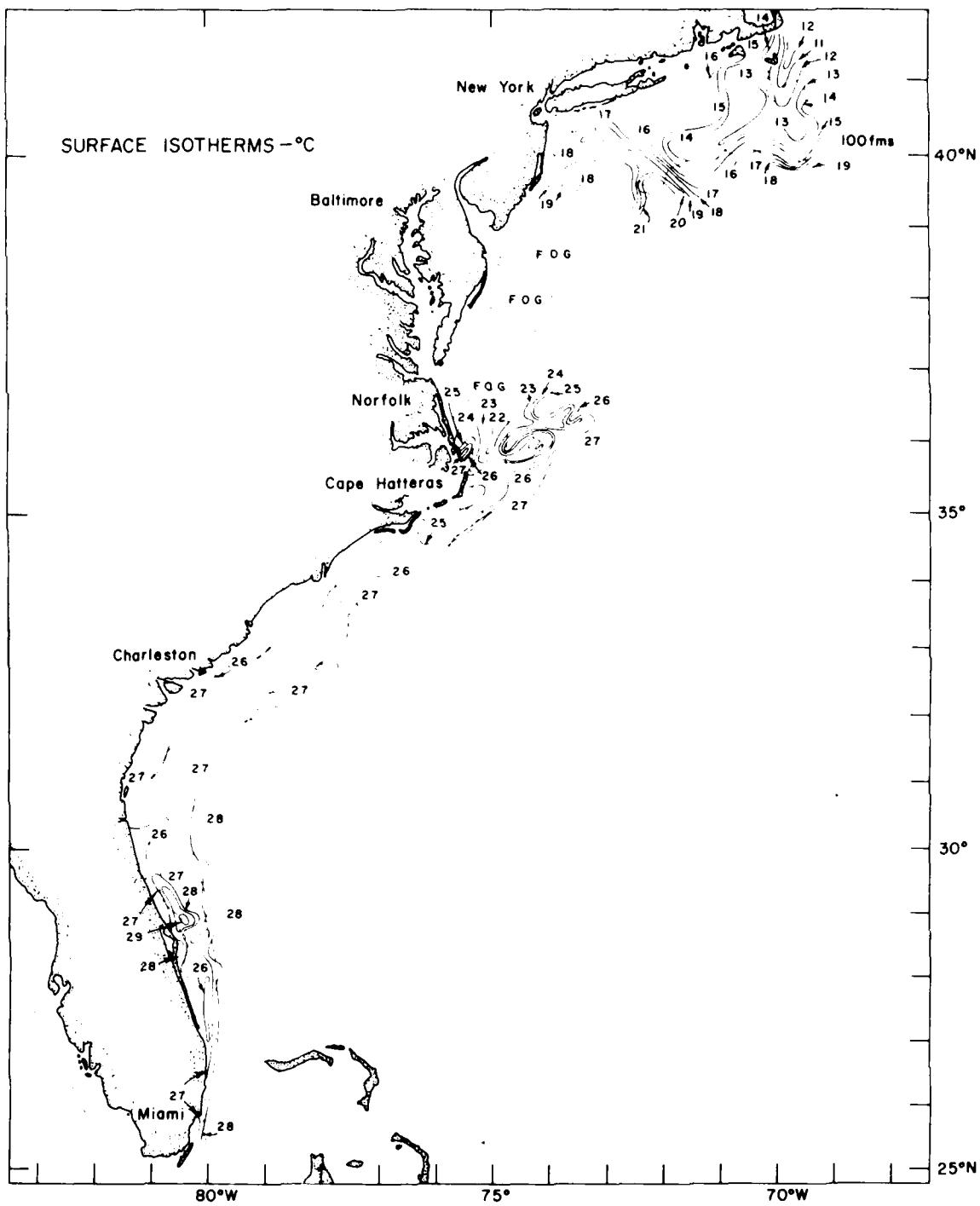


Figure 13. Monthly surface isotherm chart, 15-18, 22, 24 June 1971

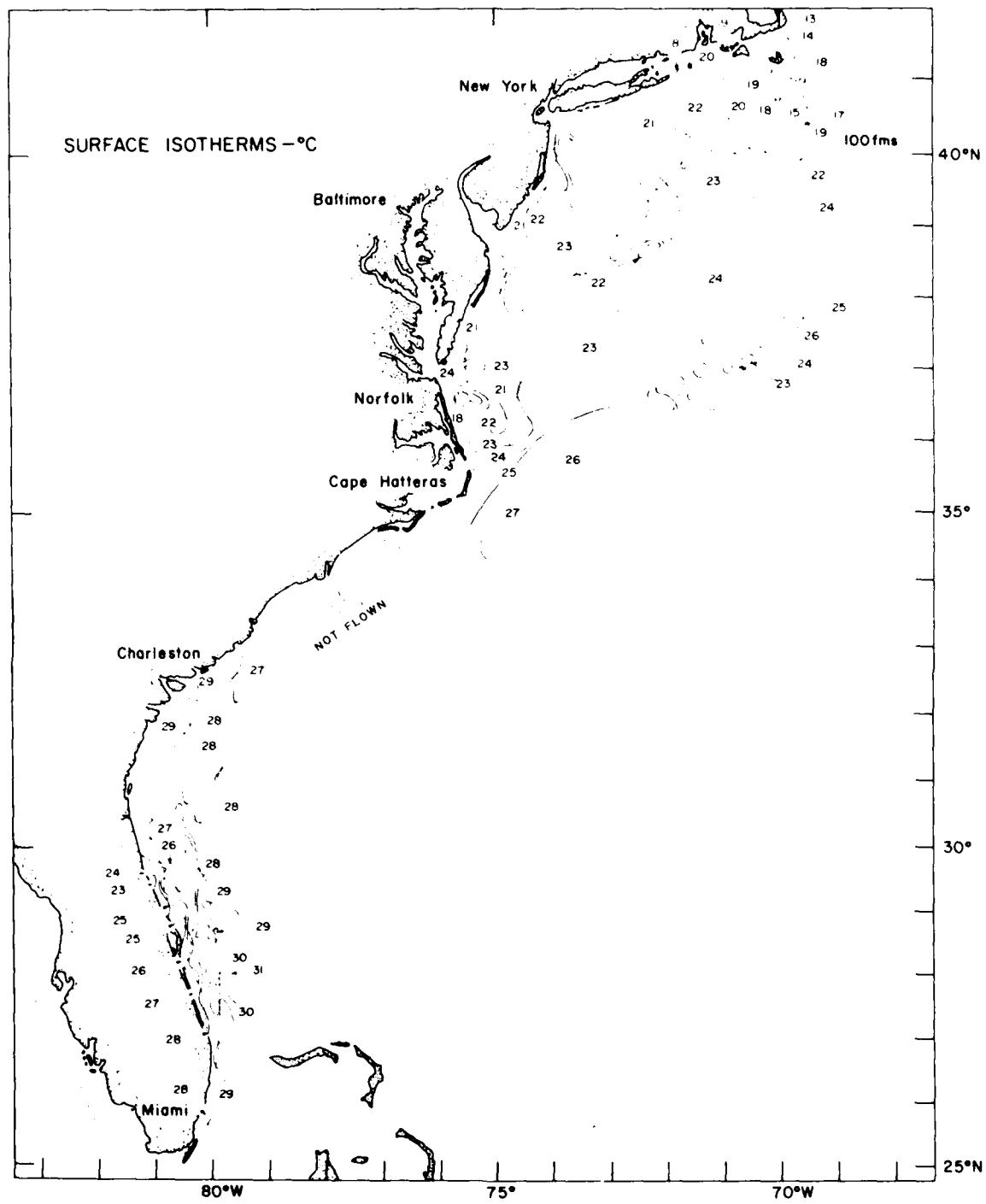


Figure 14. Monthly surface isotherm chart, 20-24 July 1971

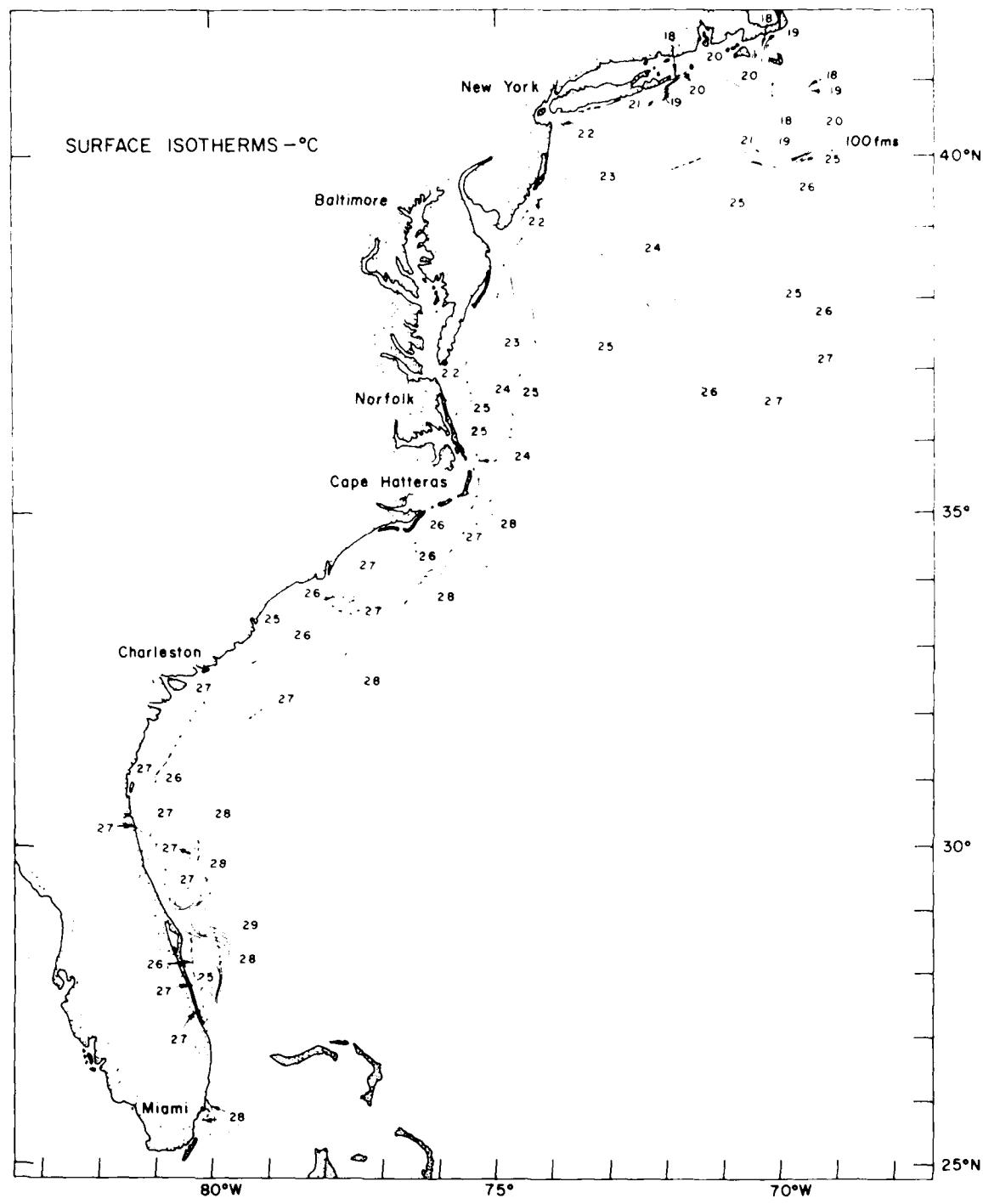


Figure 15. Monthly surface isotherm chart, 19, 23, 24, 26, '77, 30 August 1971

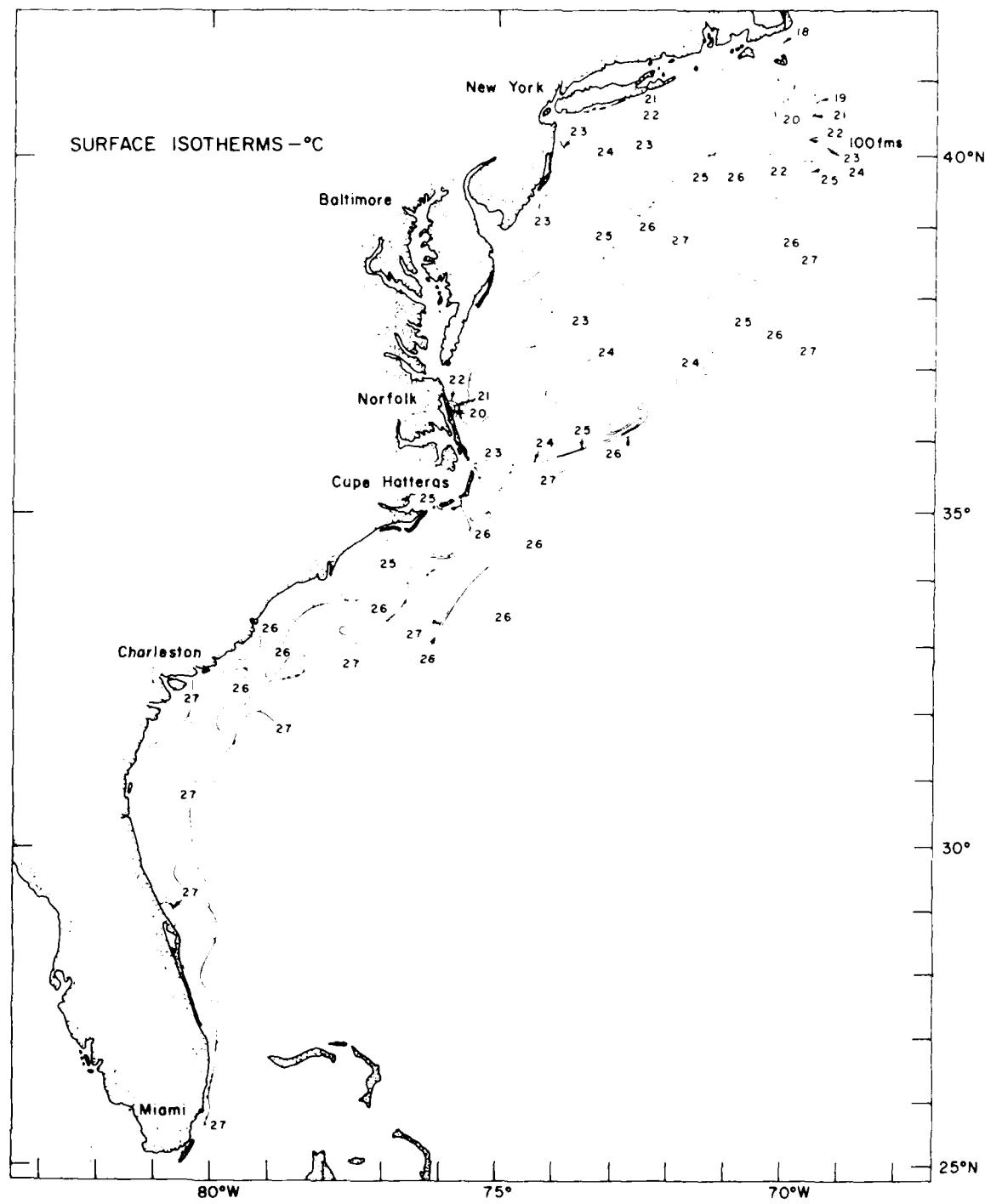


Figure 16. Monthly surface isotherm chart, 14-16, 21-23 September 1971

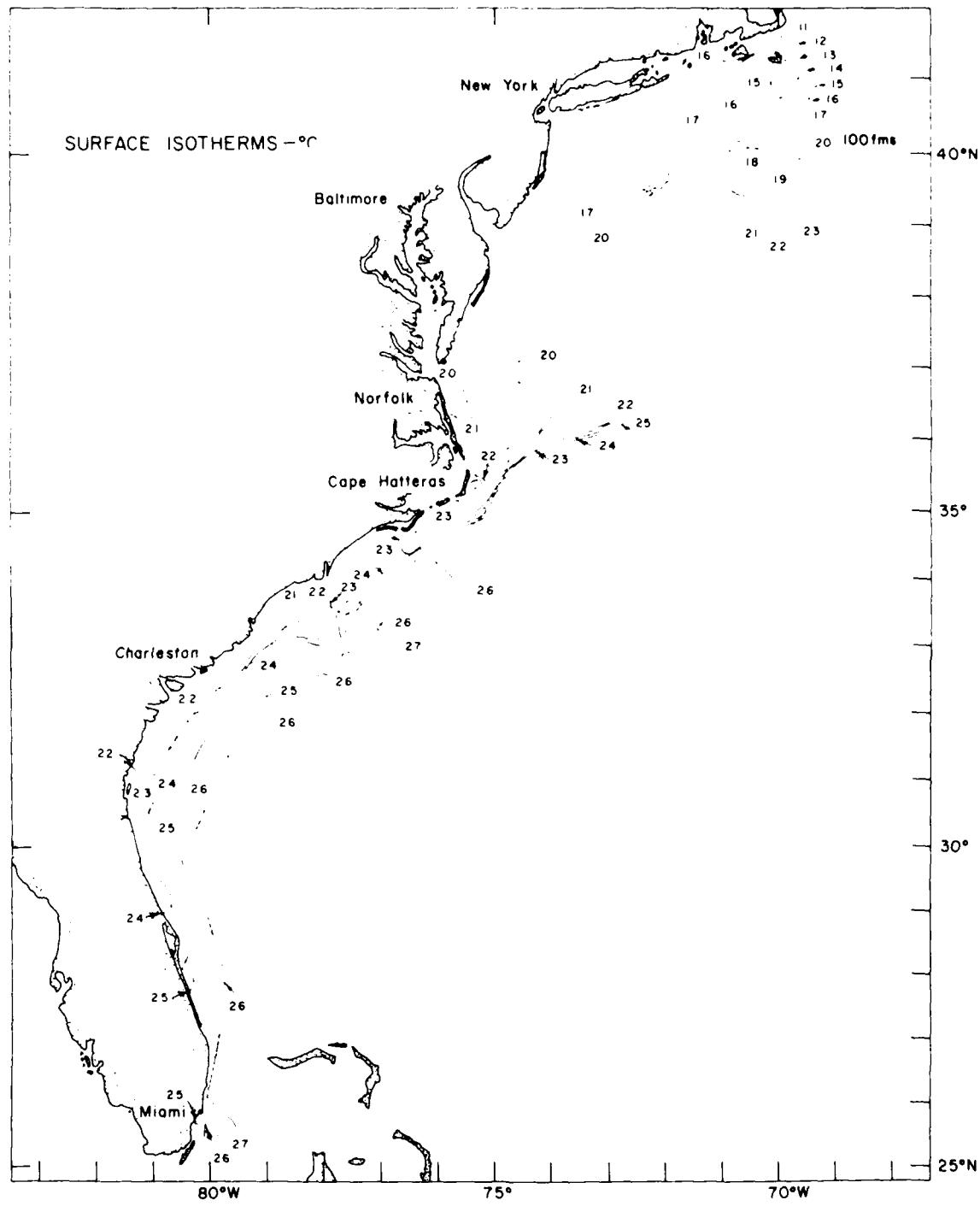


Figure 17. Monthly surface isotherm chart, 12, 14, 15, 26-28 October 1971

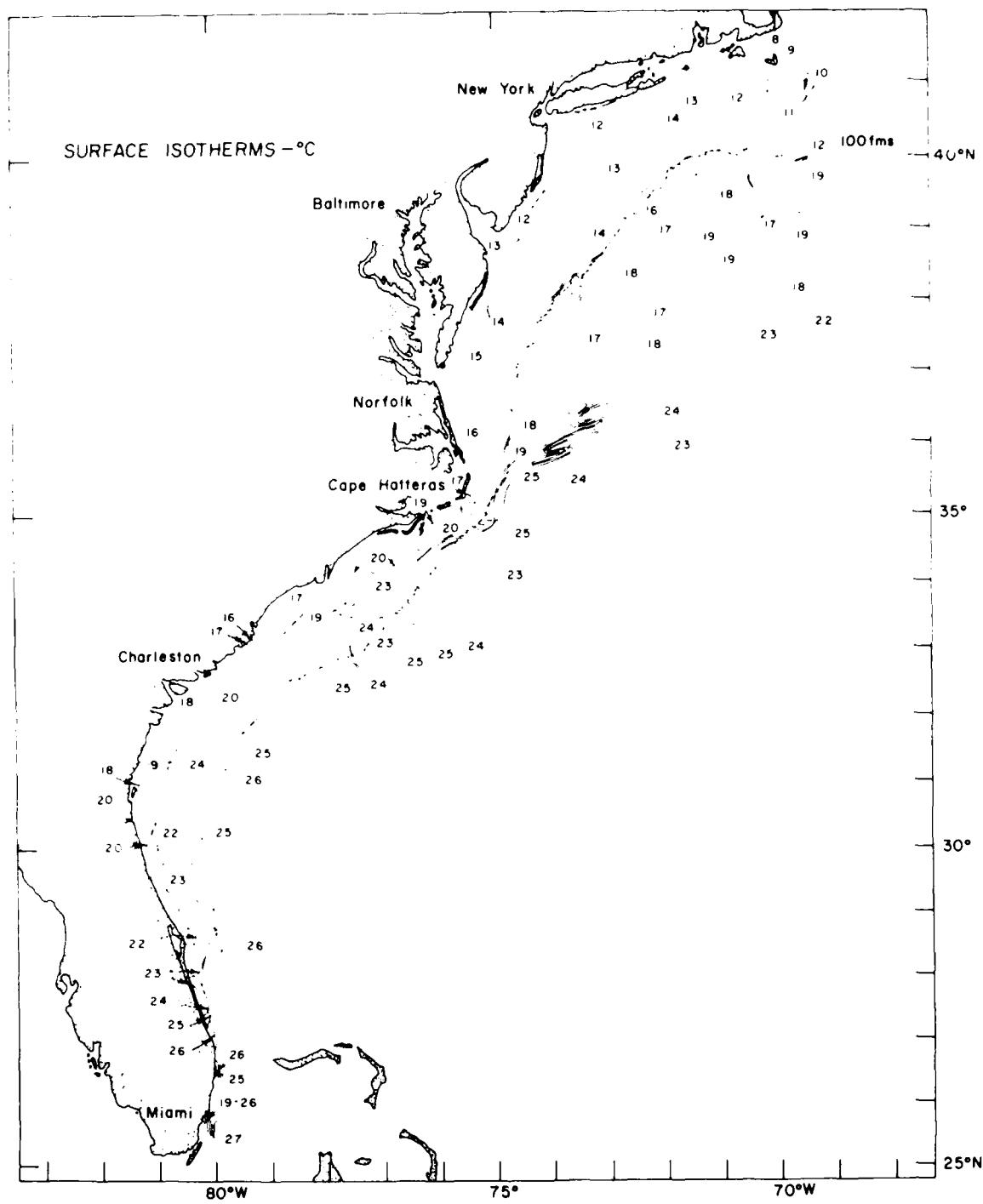


Figure 18. Monthly surface isotherm chart, 16-19 November 1971

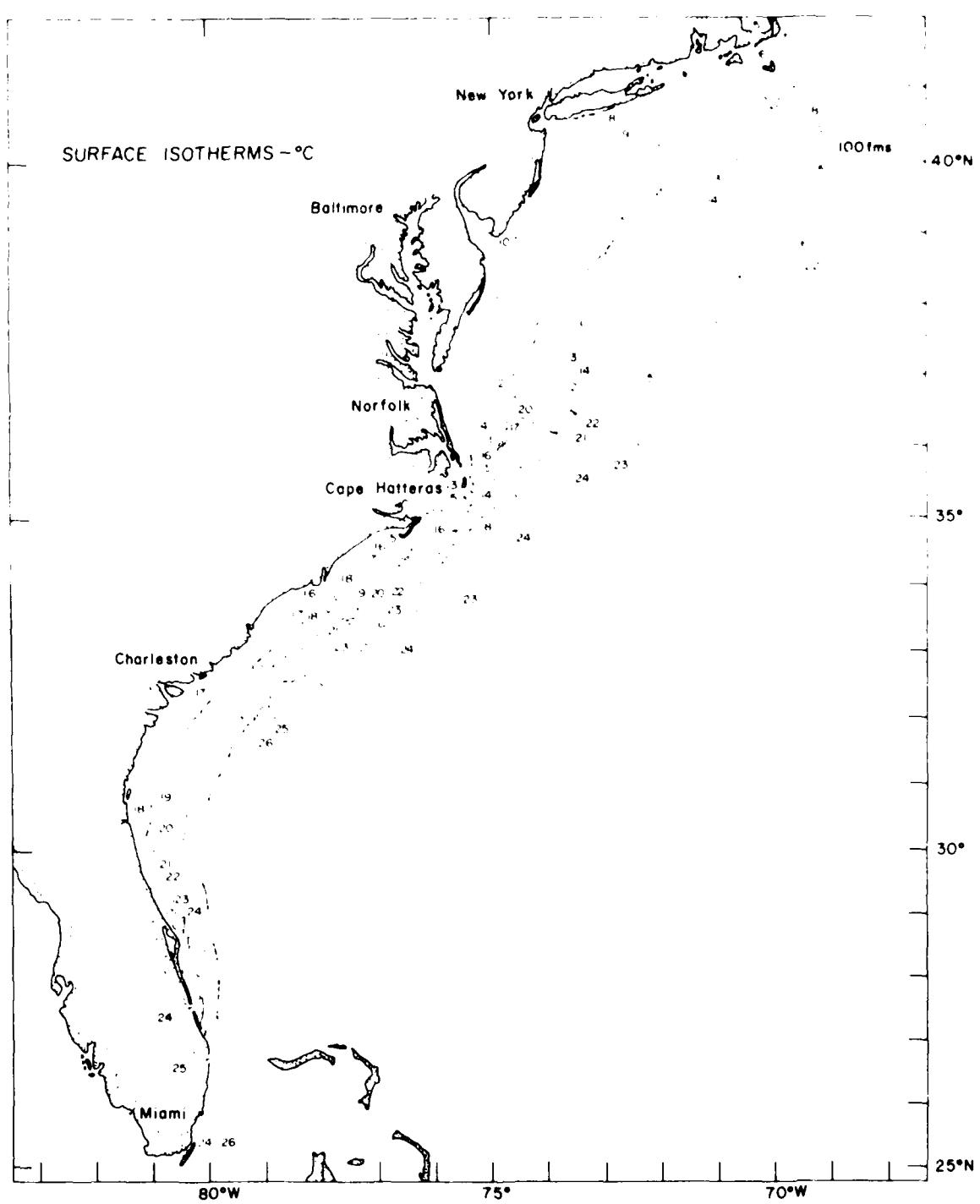


Figure 19. Monthly surface isotherm chart, 14-17 December 1971

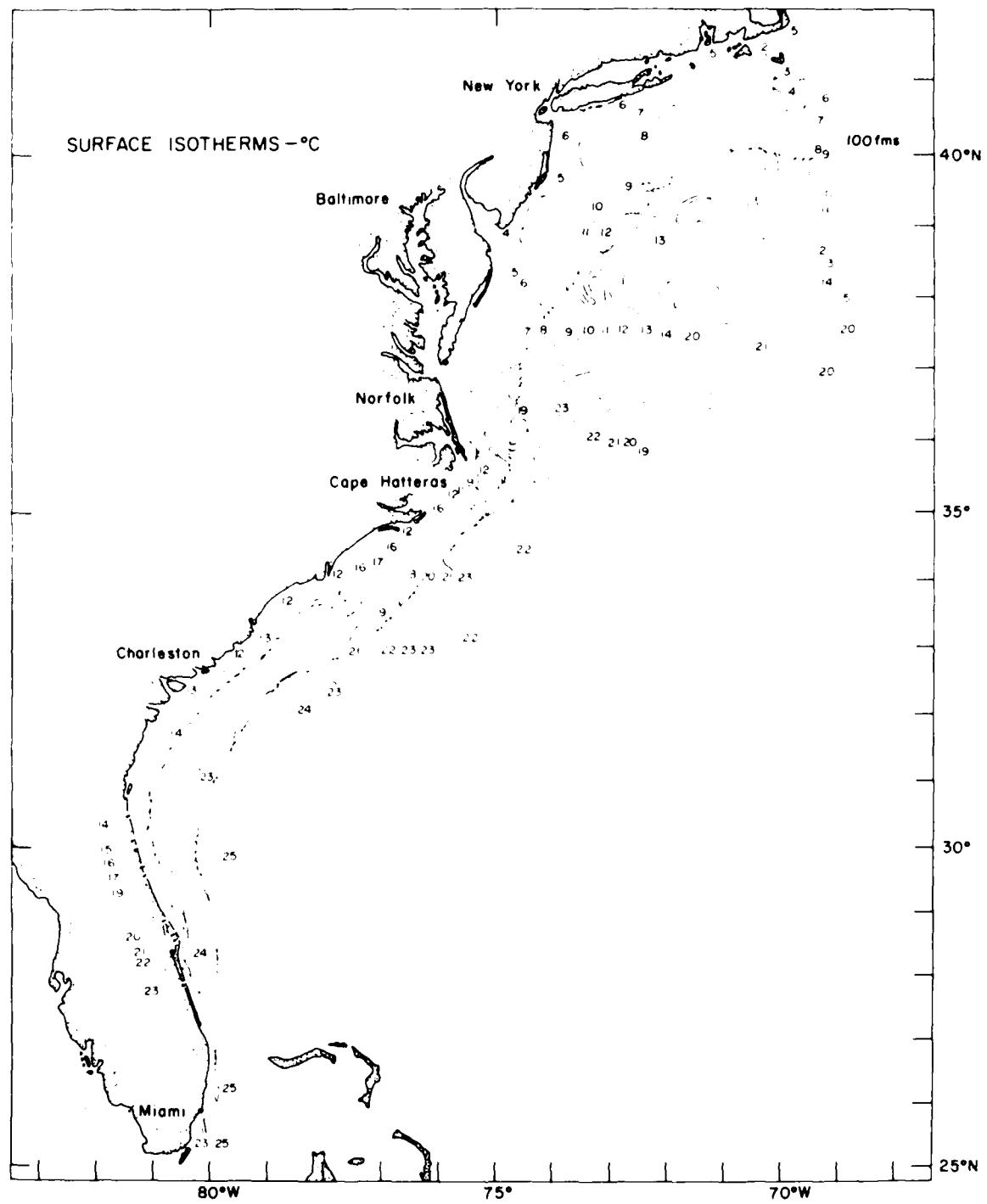


Figure 20. Monthly surface isotherm chart, 18-20, 25-27 January 1972

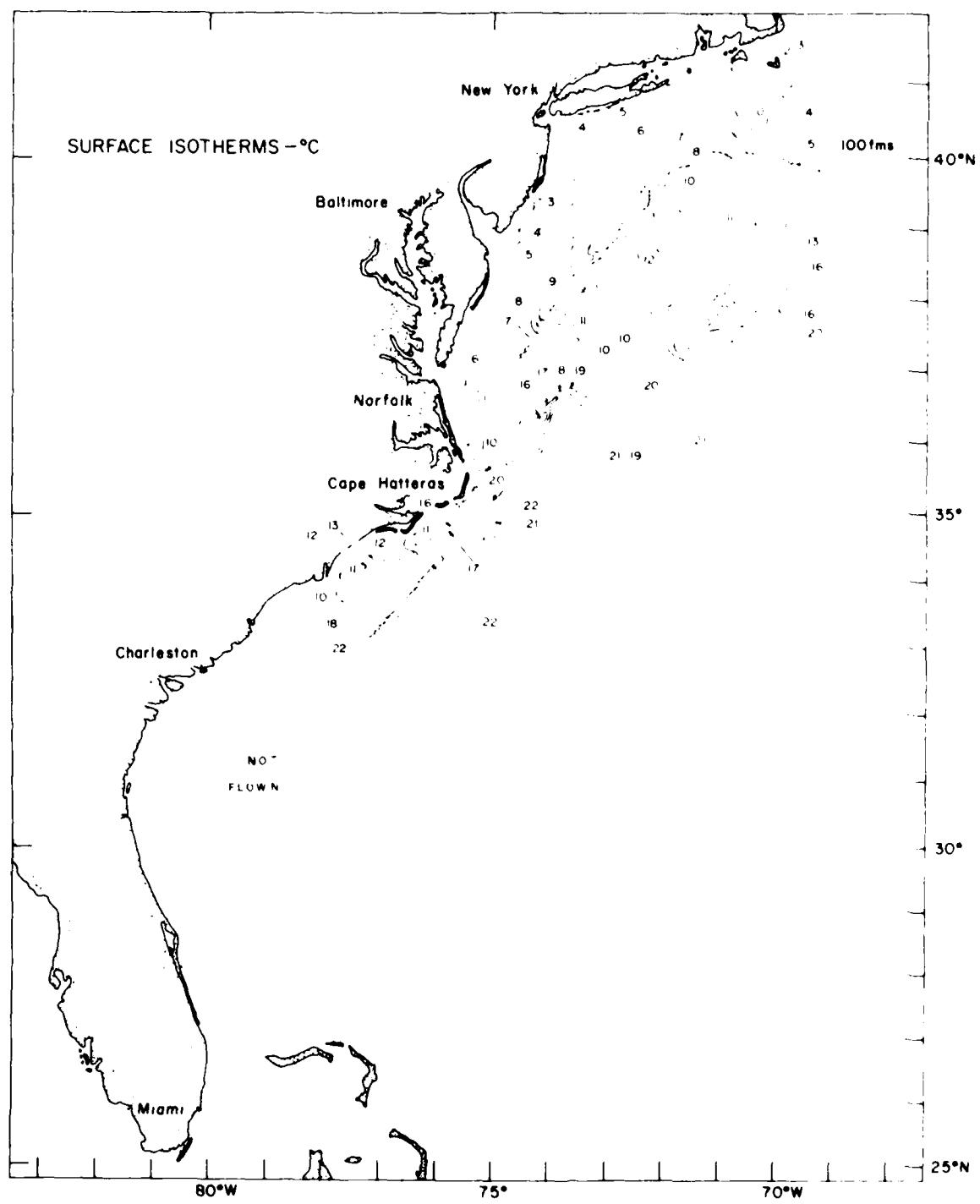


Figure 21. Monthly surface isotherm chart, 15-17, 22 February 1972

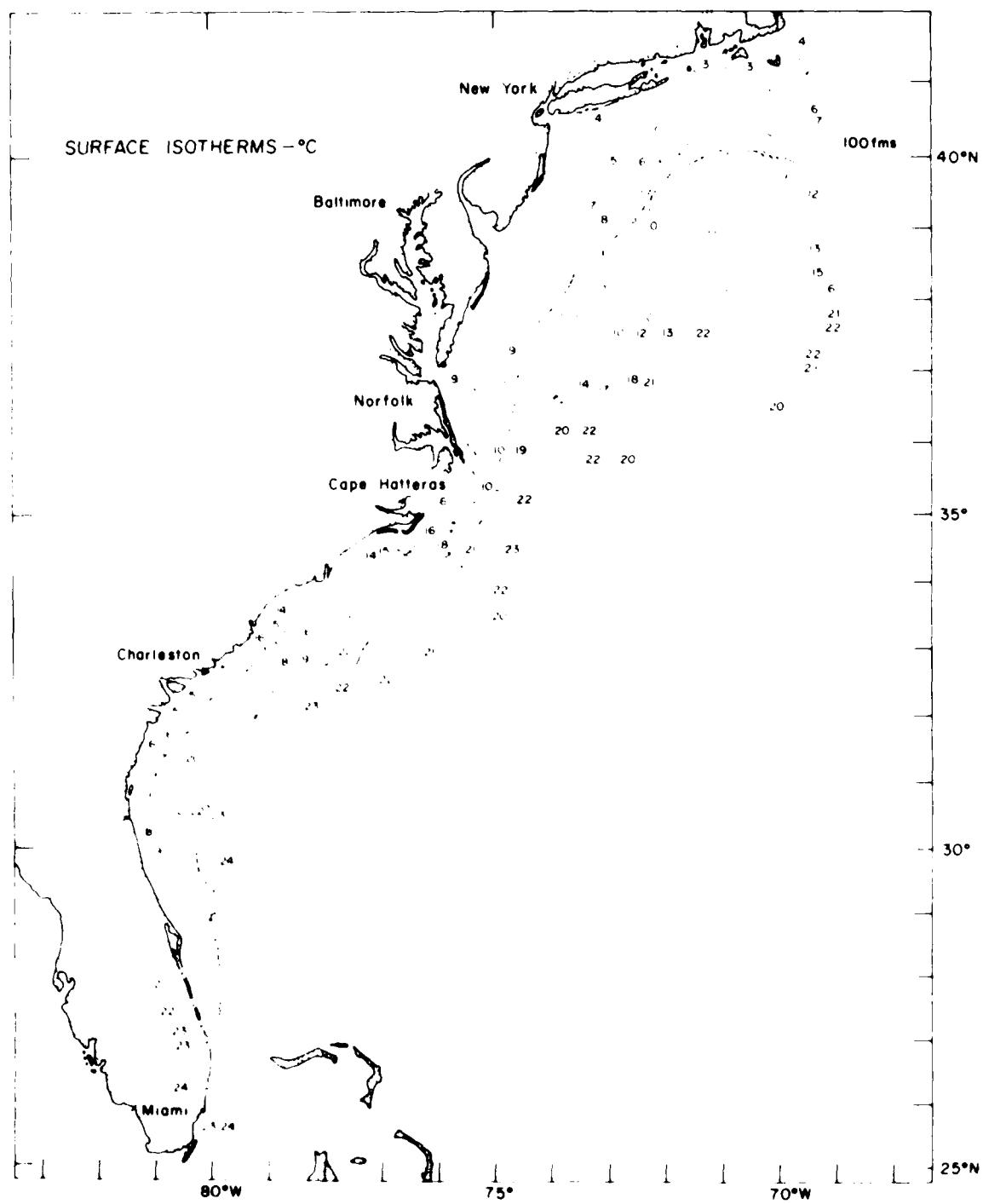


Figure 22 Monthly surface isotherm chart, 21-24 March 1972

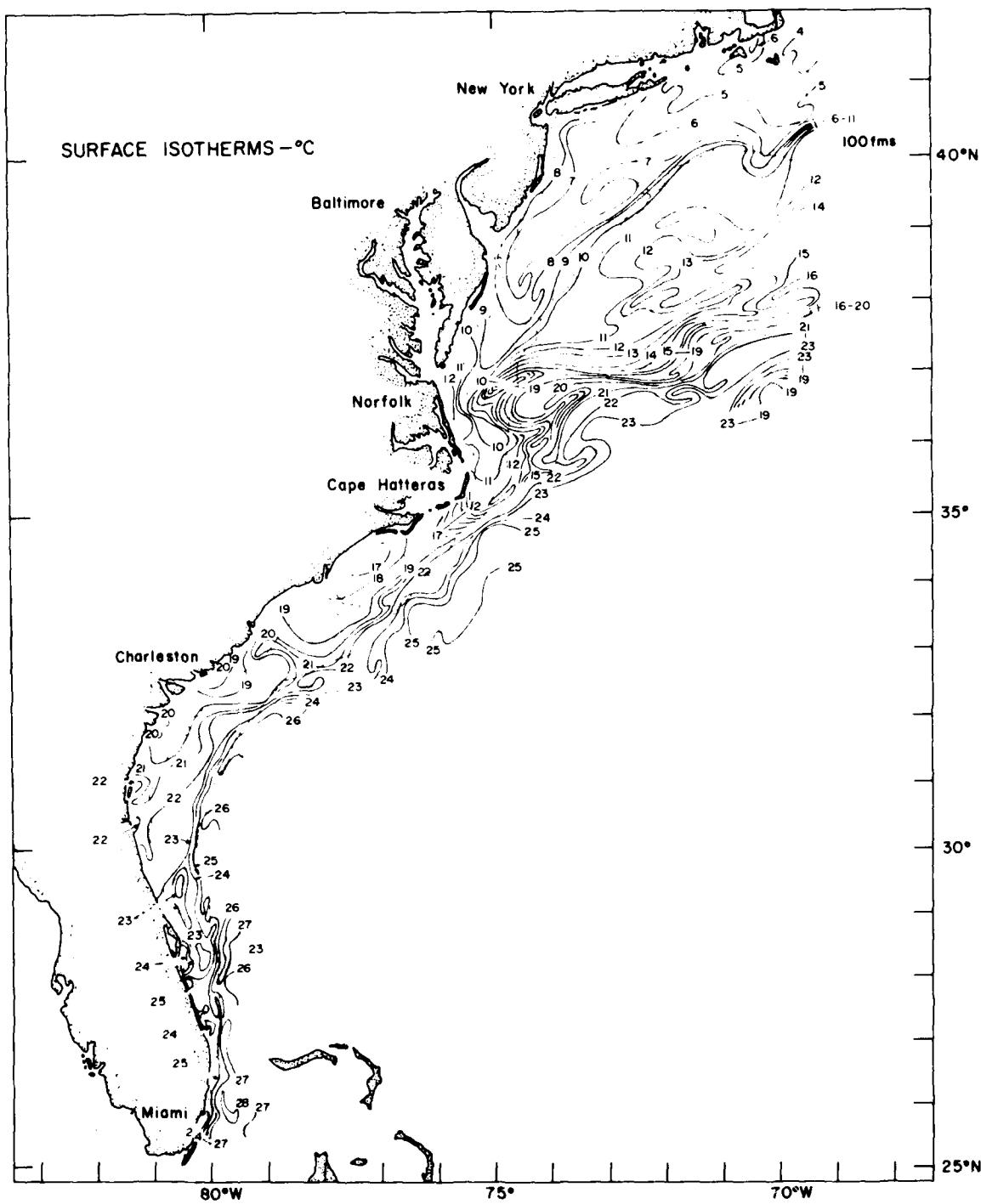


Figure 23. Monthly surface isotherm chart, 18-21 April 1972

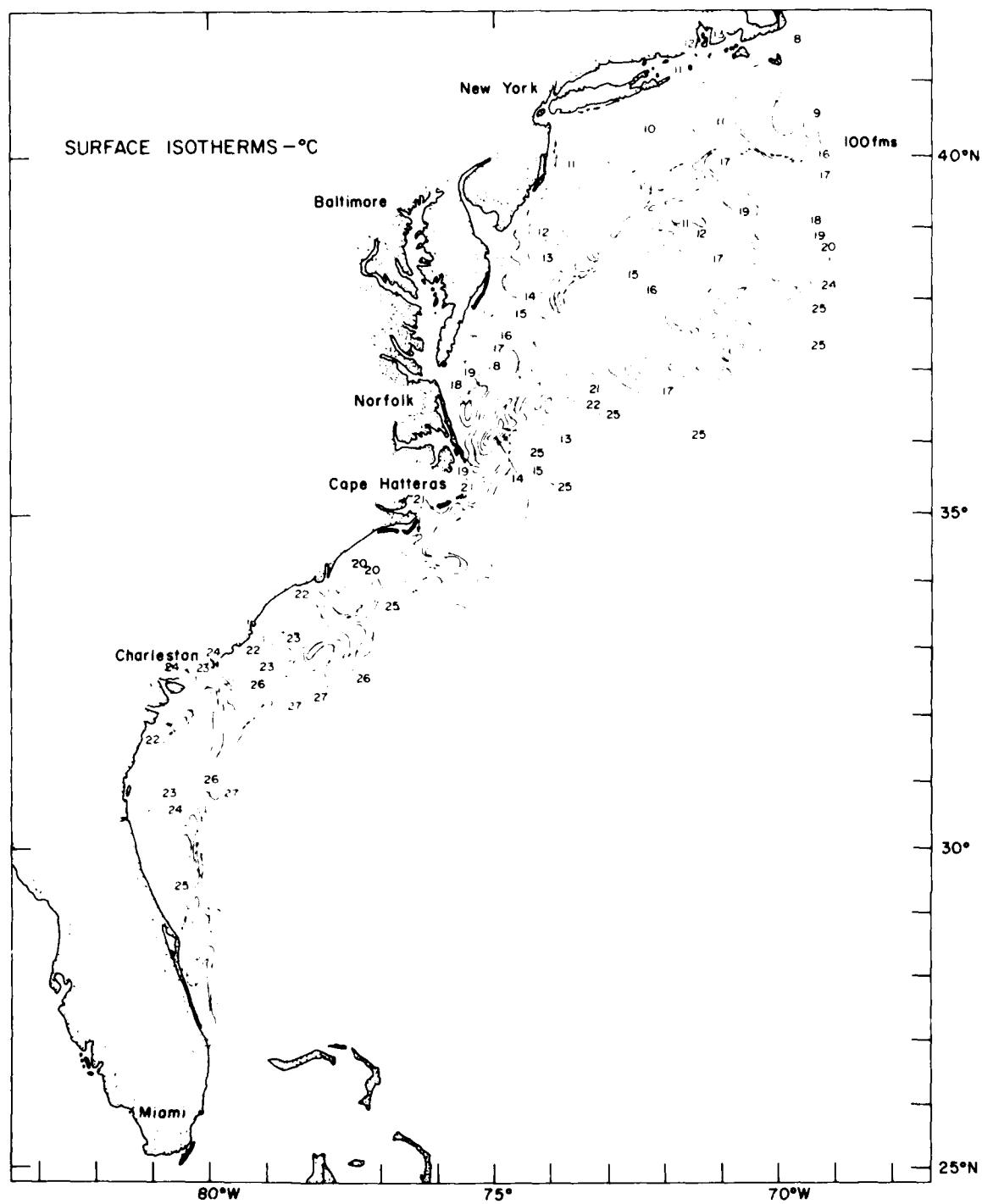


Figure 24. Monthly surface isotherm chart, 16-18, 23, May 1972

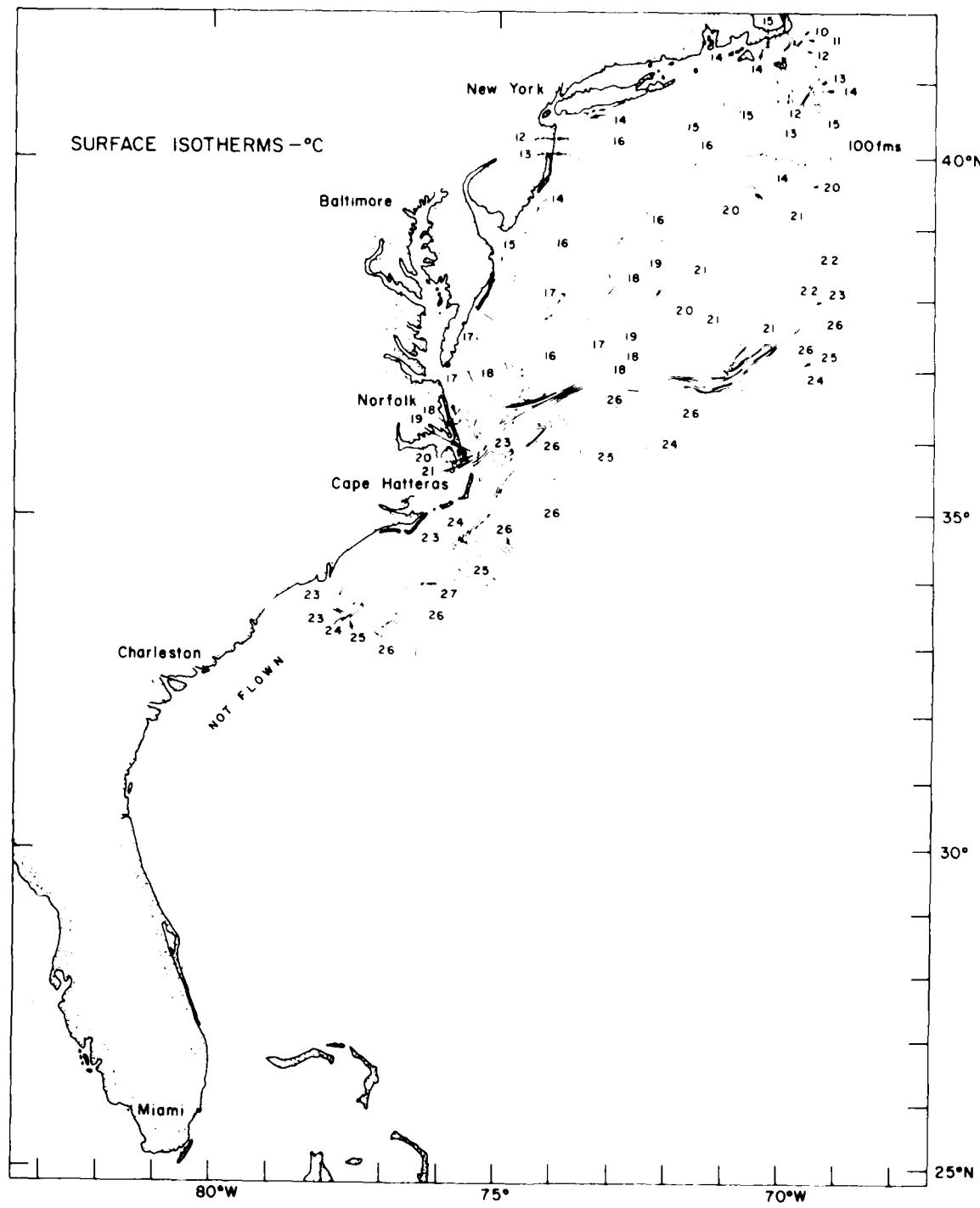


Figure 25. Monthly surface isotherm chart, 13-16, 21 June 1972

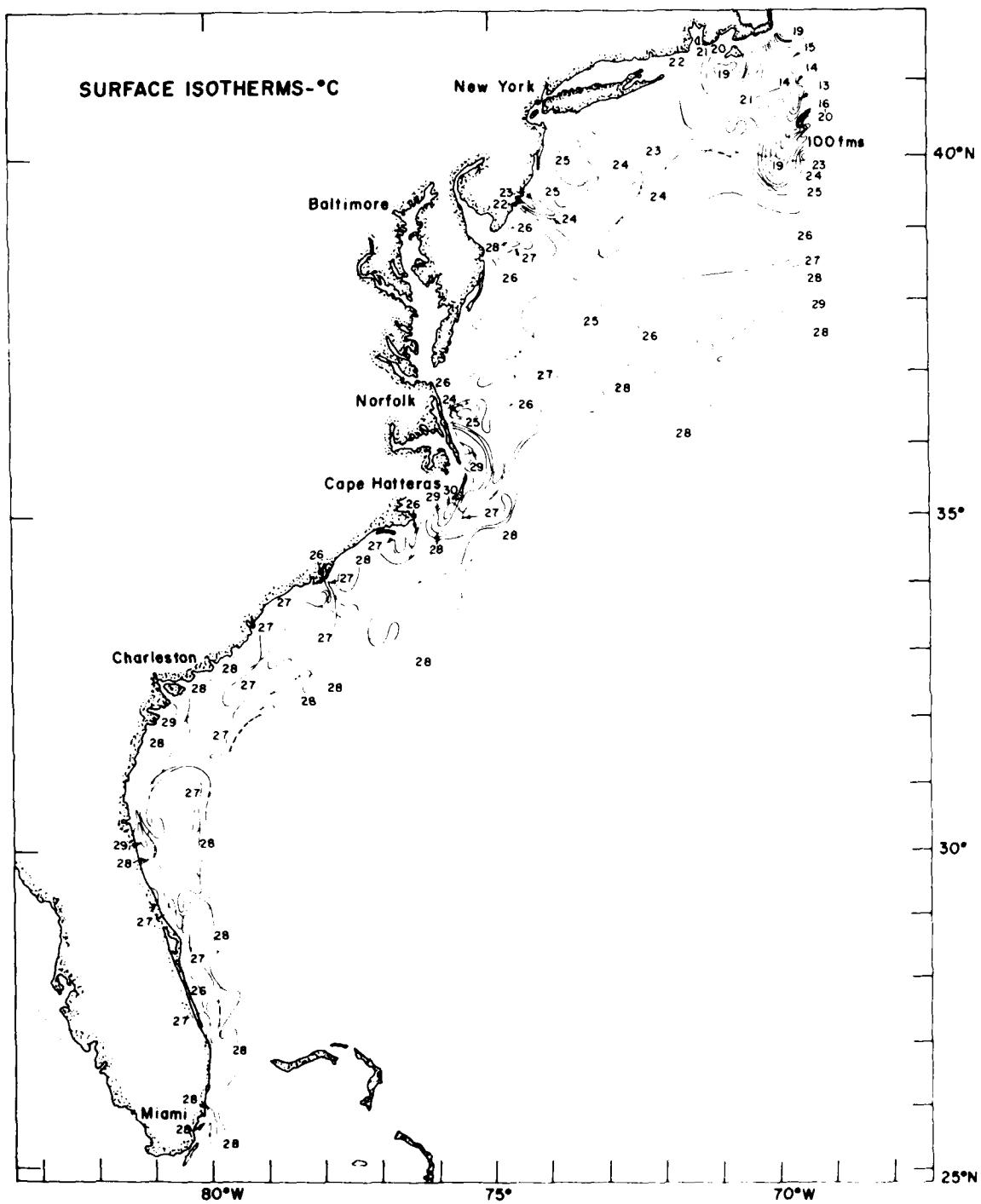


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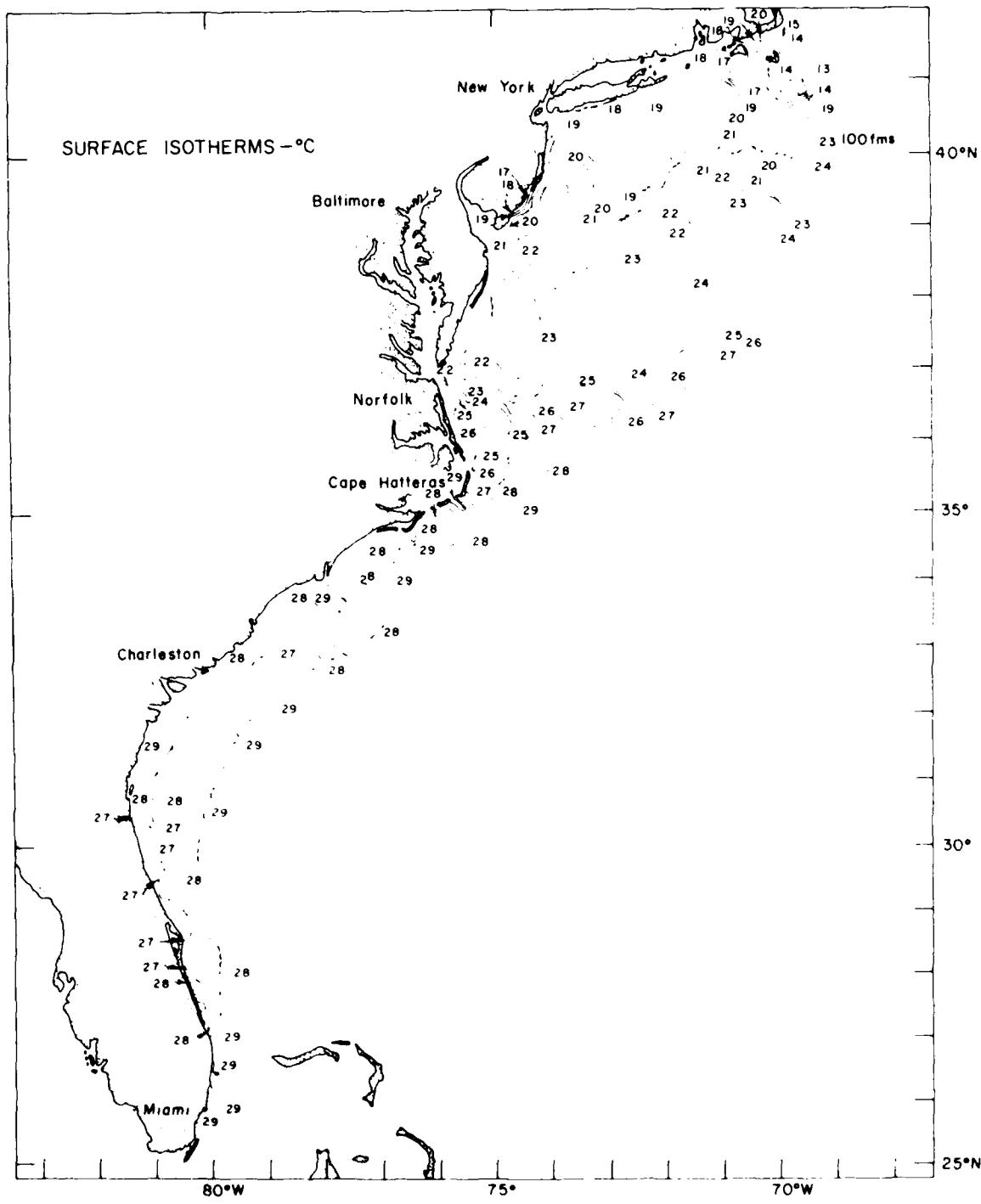


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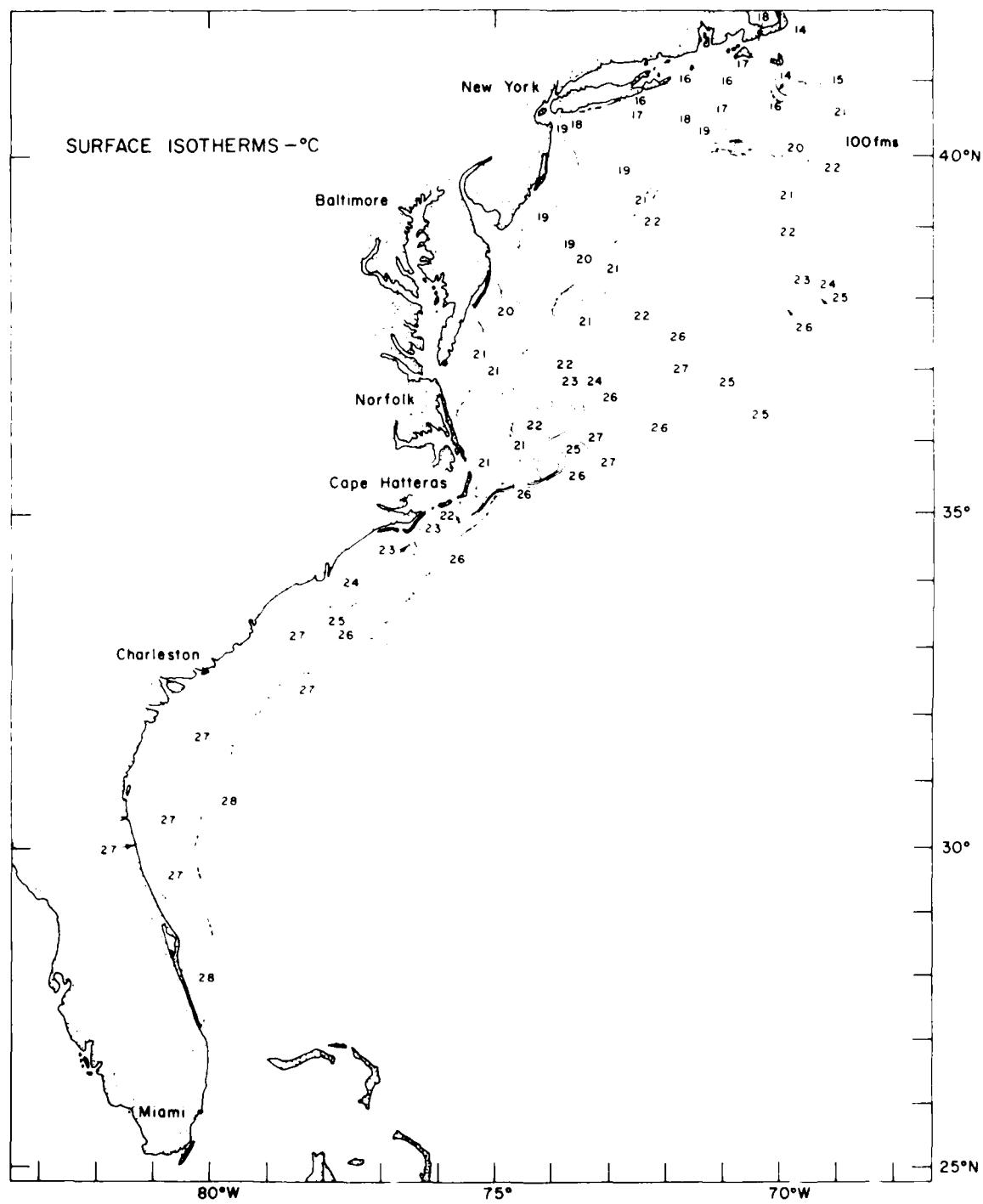


Figure 28. Monthly surface isotherm chart, 22, 23, 25, 27 September 1972

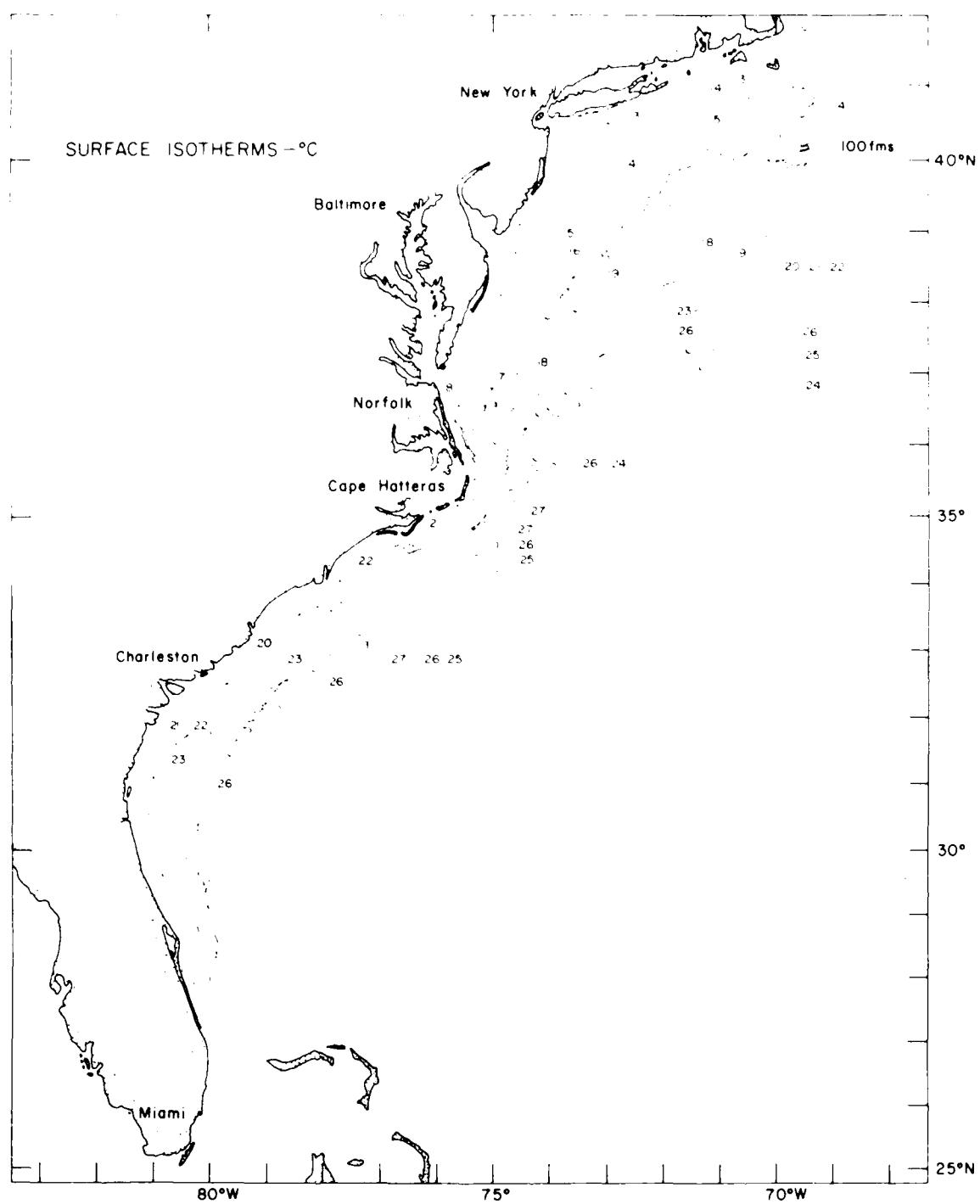


Figure 29. Monthly surface isotherm chart, 18, 20, 27, 29, 30 October 1972

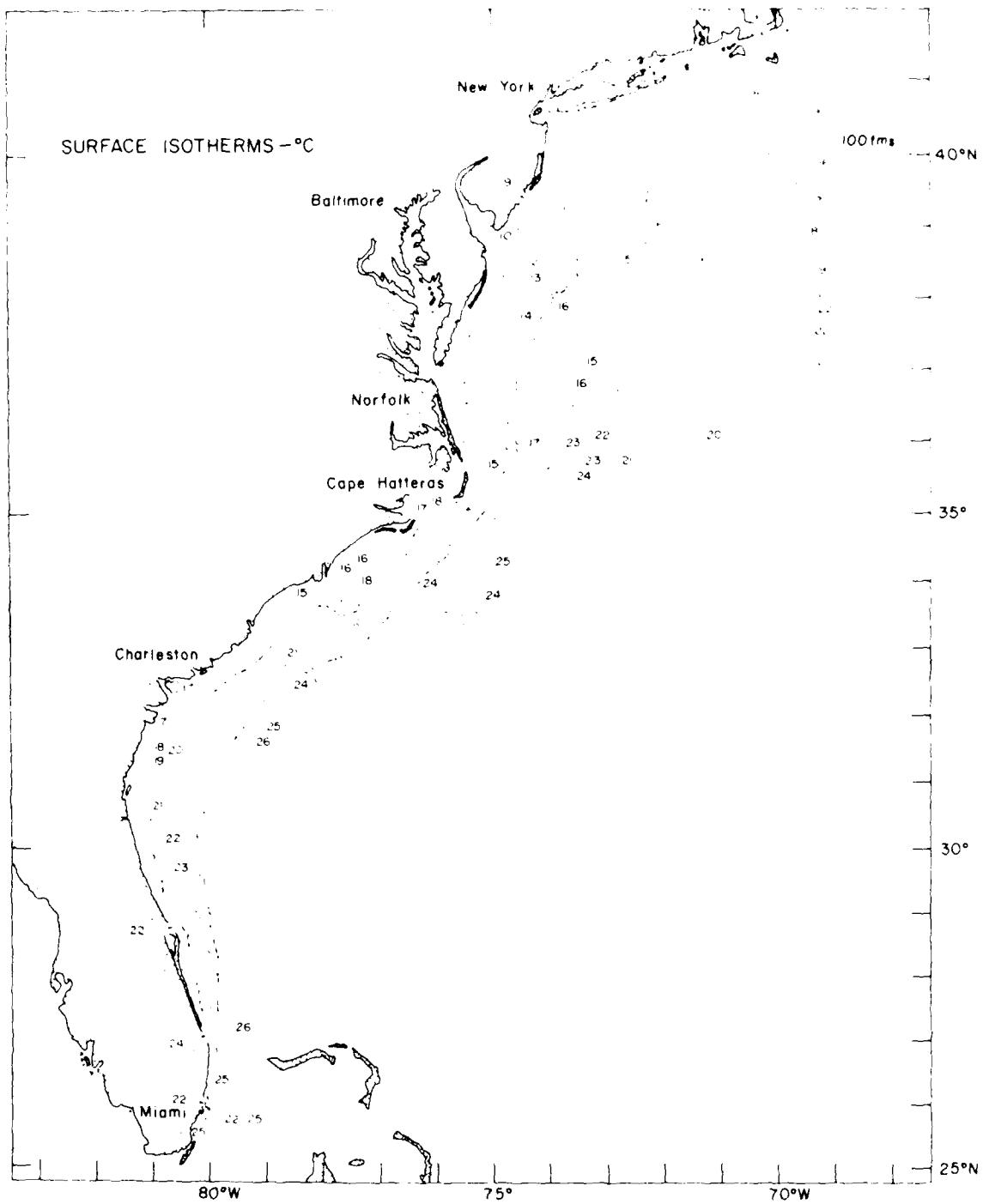


Figure 30. Monthly surface isotherm chart, 16, 18, 19, 21, 22 November 1972

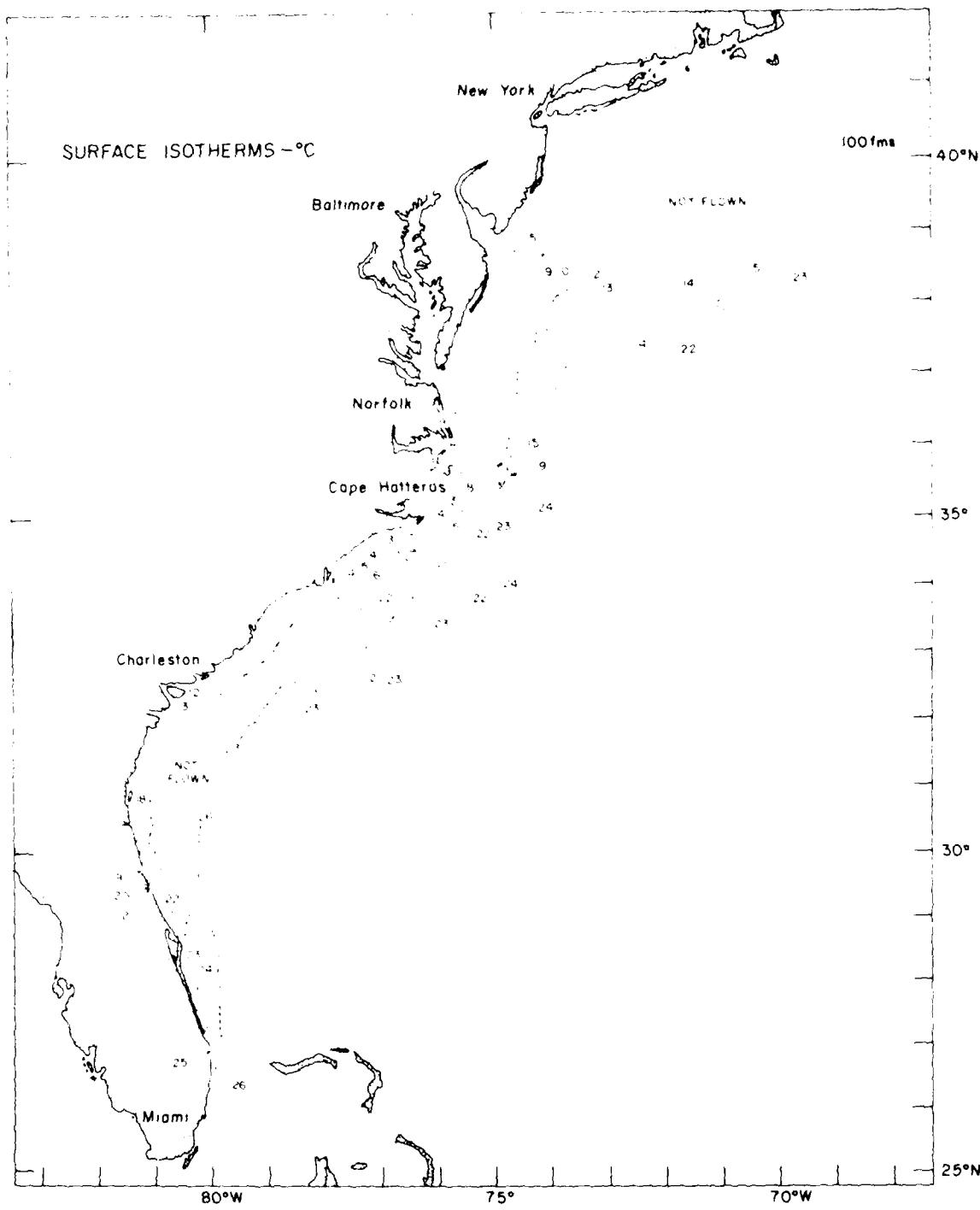


Figure 31. Monthly surface isotherm chart, 13, 14, 18-20, December 1972

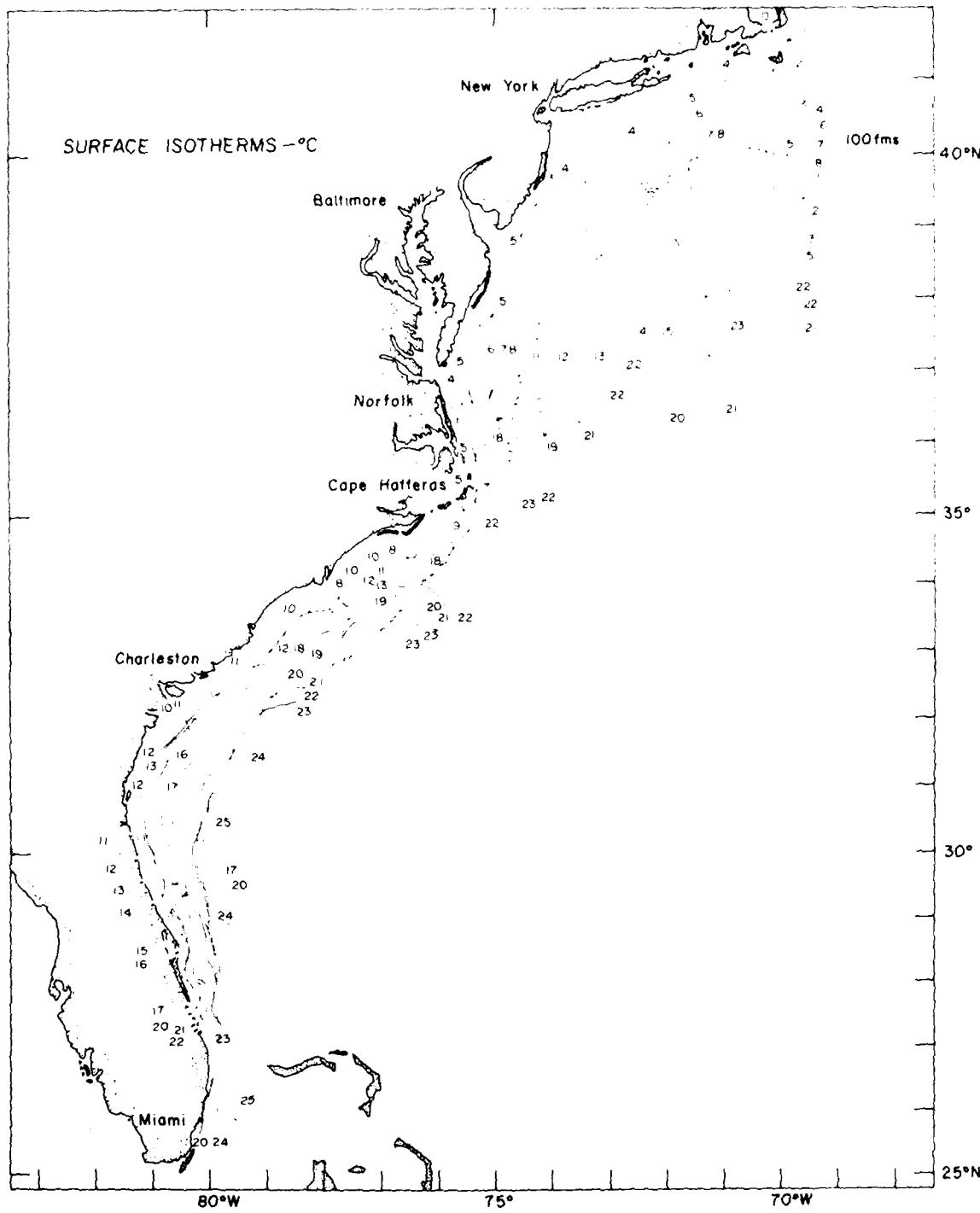


Figure 32. Monthly surface isotherm chart, 16, 17, 19, 24 January 1973

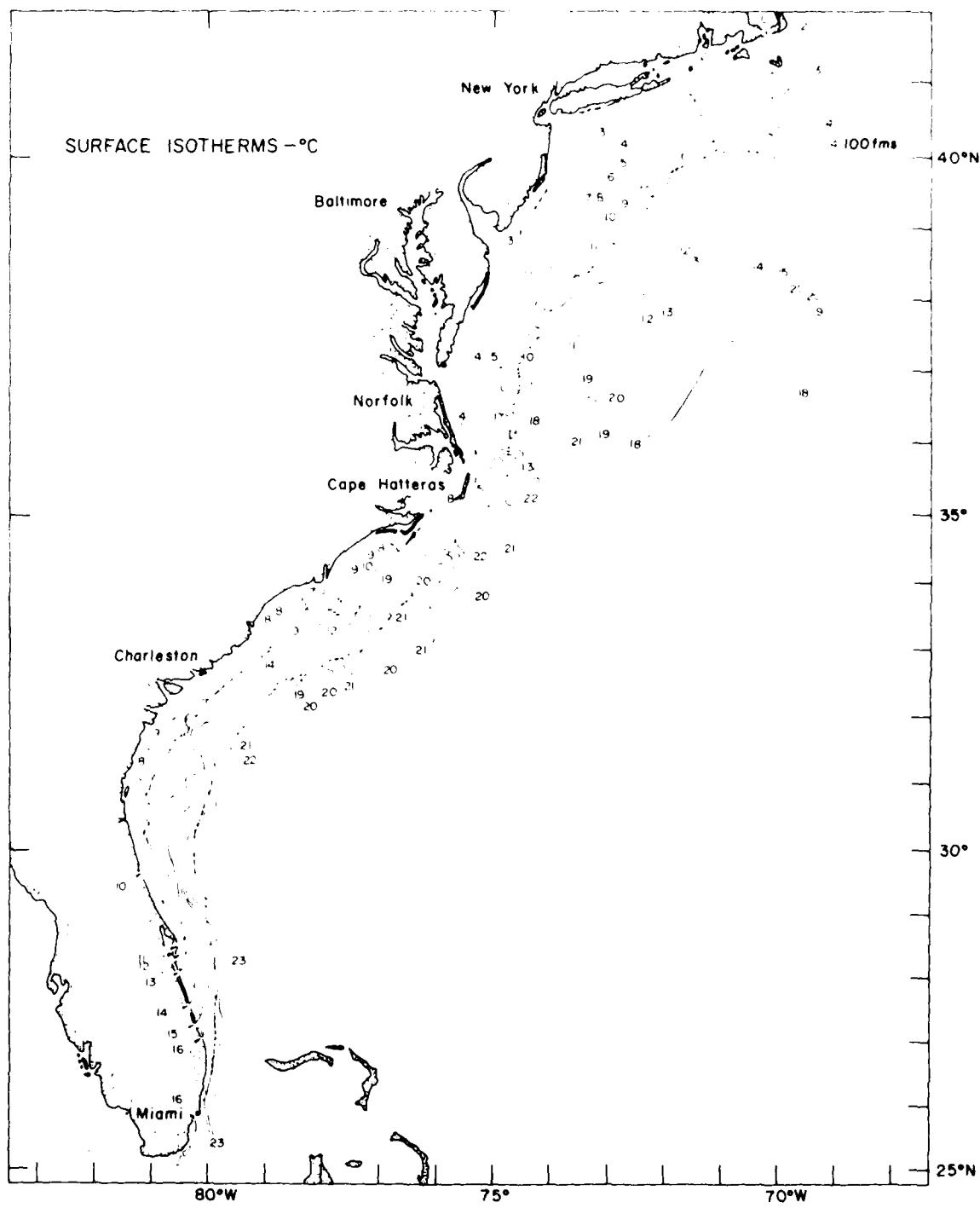


Figure 33. Monthly surface isotherm chart, 20-23 February 1973

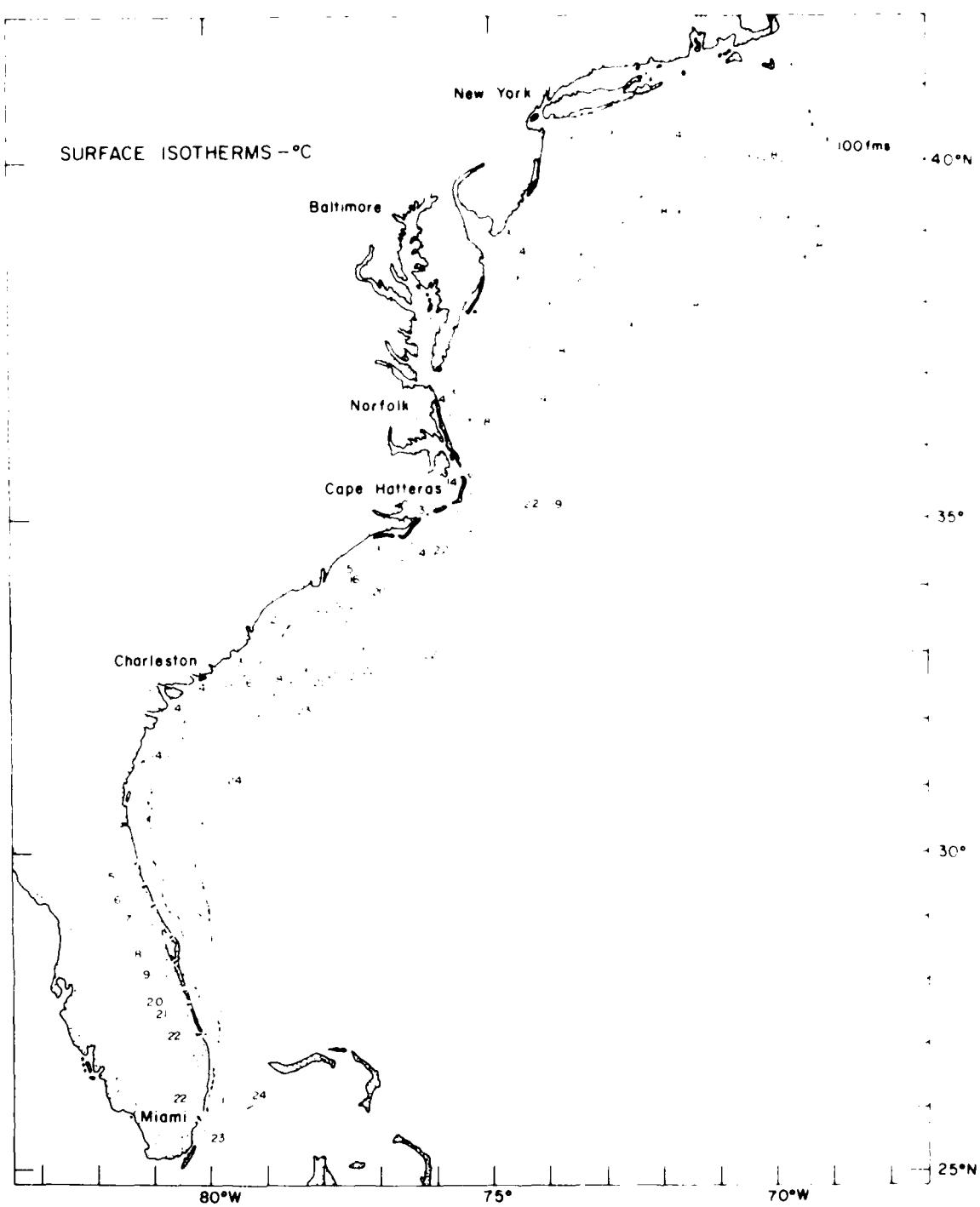


Figure 34. Monthly surface isotherm chart, 20, 22-24, 27, 28 March 1973

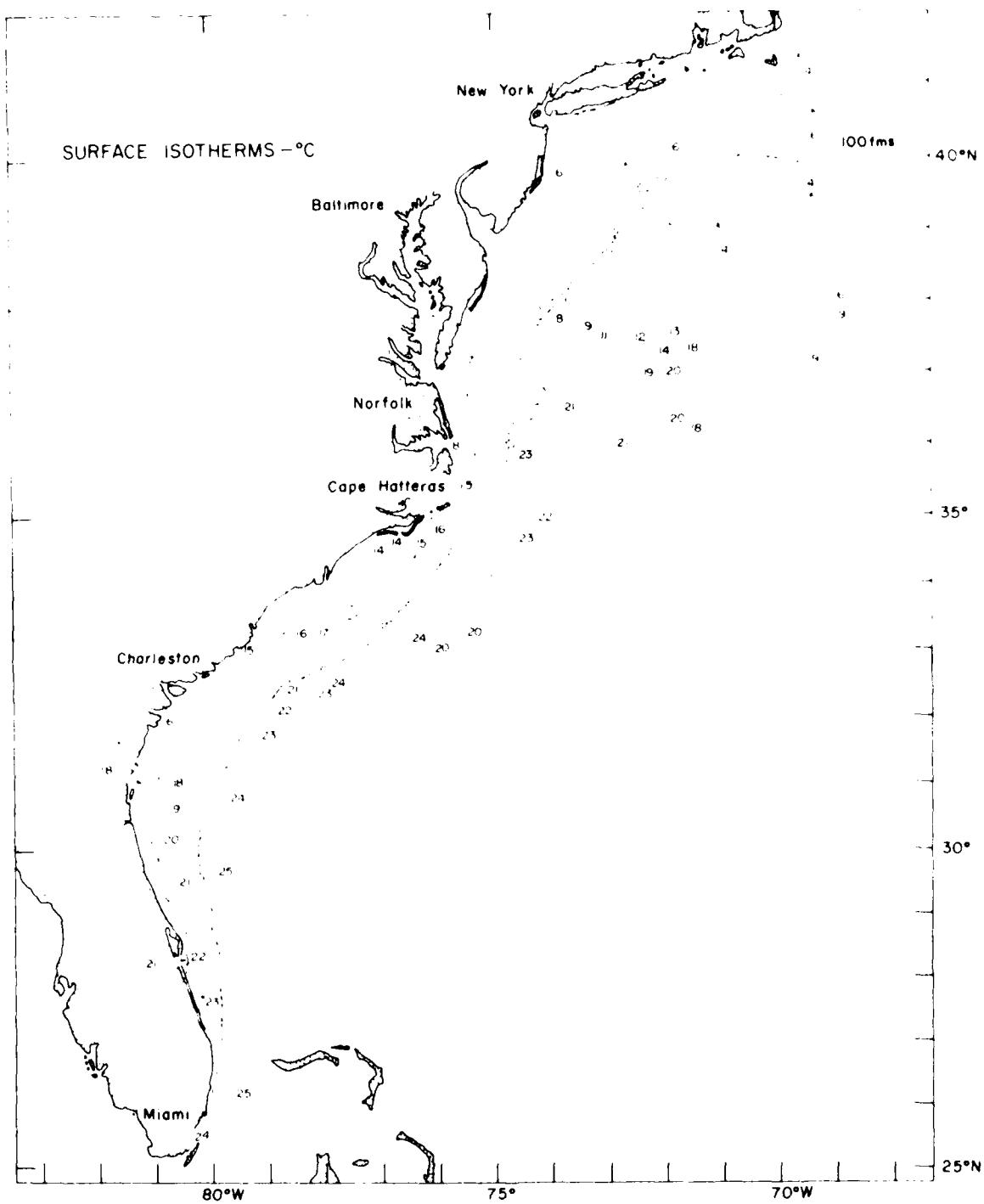


Figure 35. Monthly surface isotherm chart, 9, 11-15 April 1973

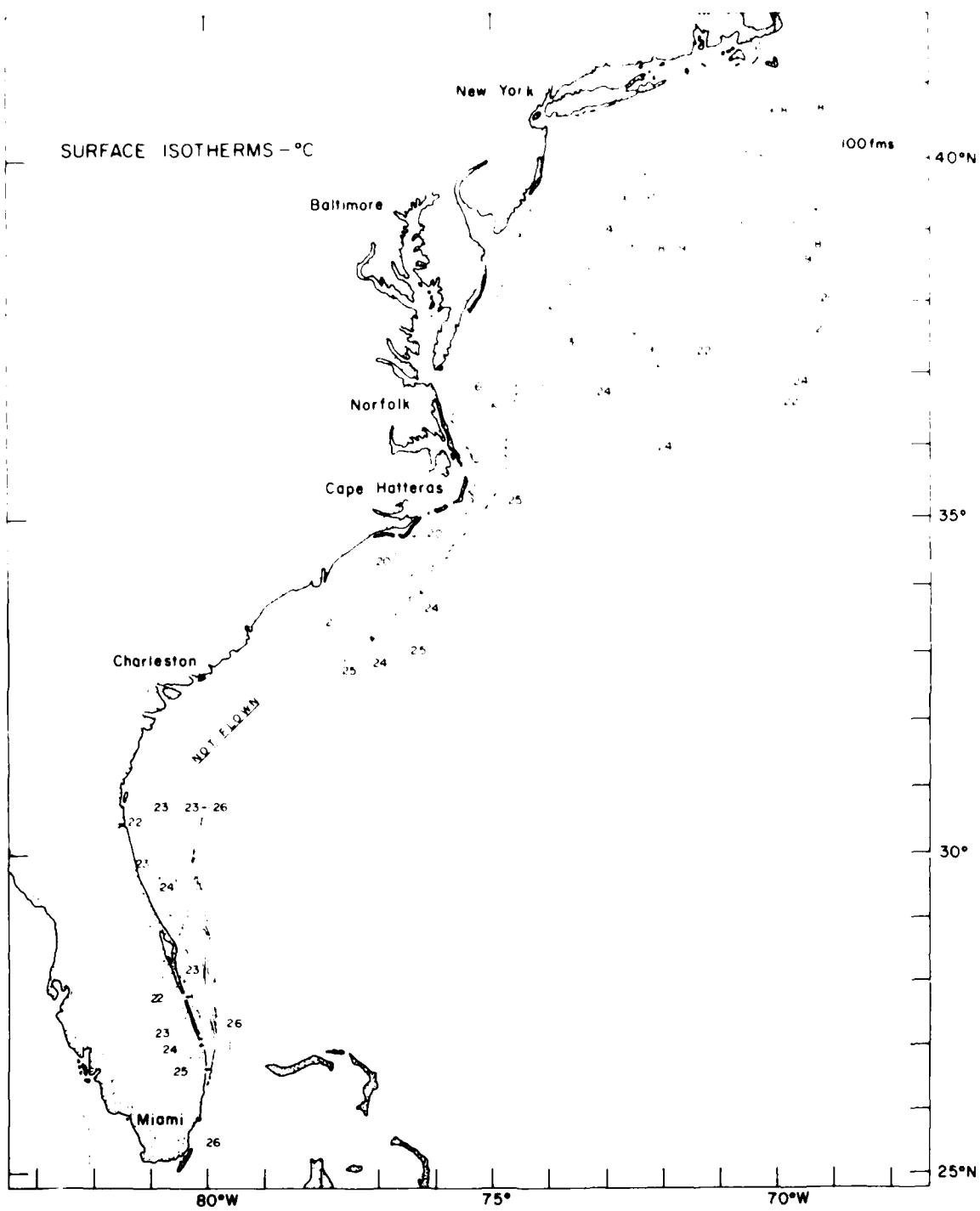


Figure 36. Monthly surface isotherm chart, 16, 17, 19 May 1973

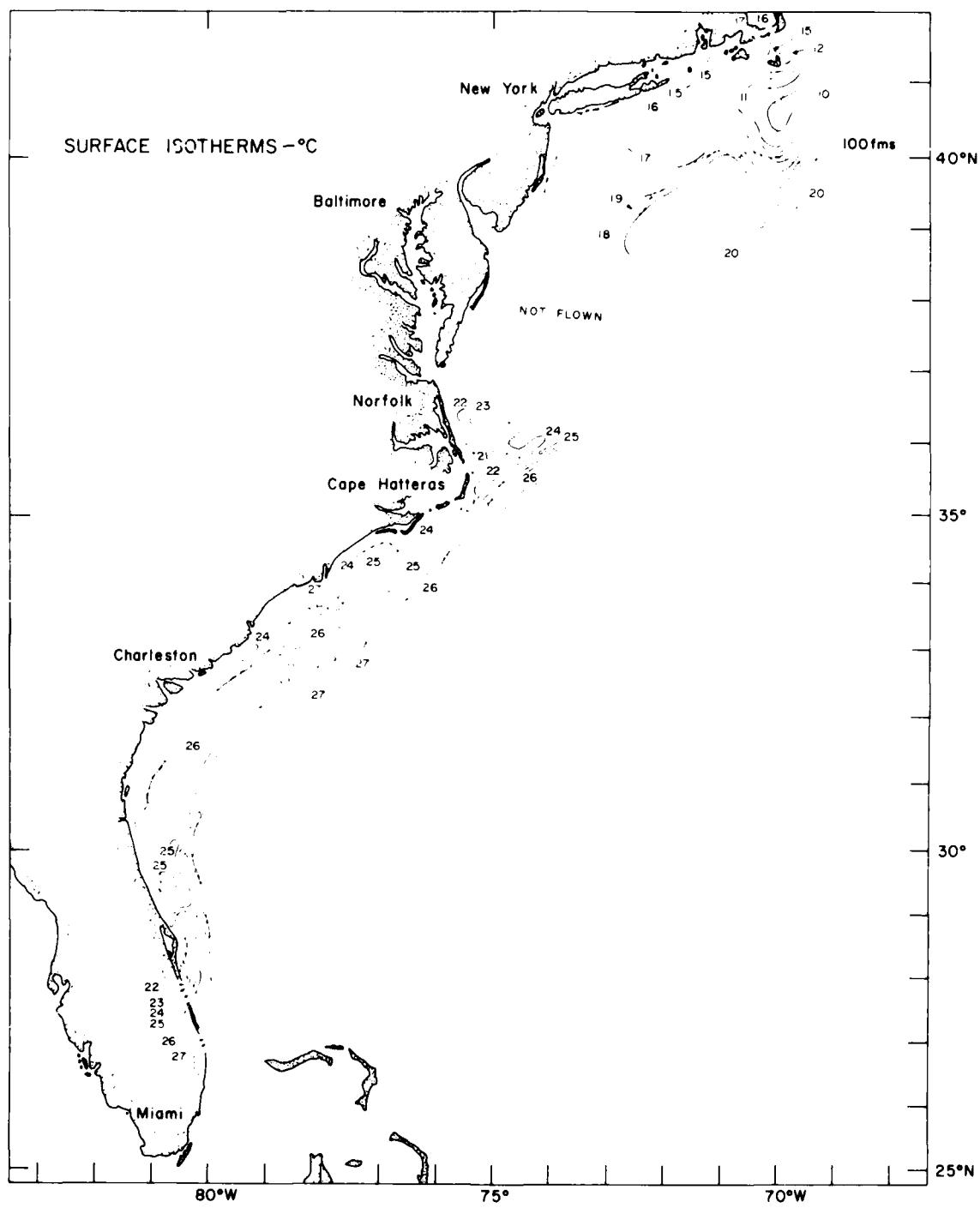


Figure 37. Monthly surface isotherm chart, 19-21, 23-25 June 1973

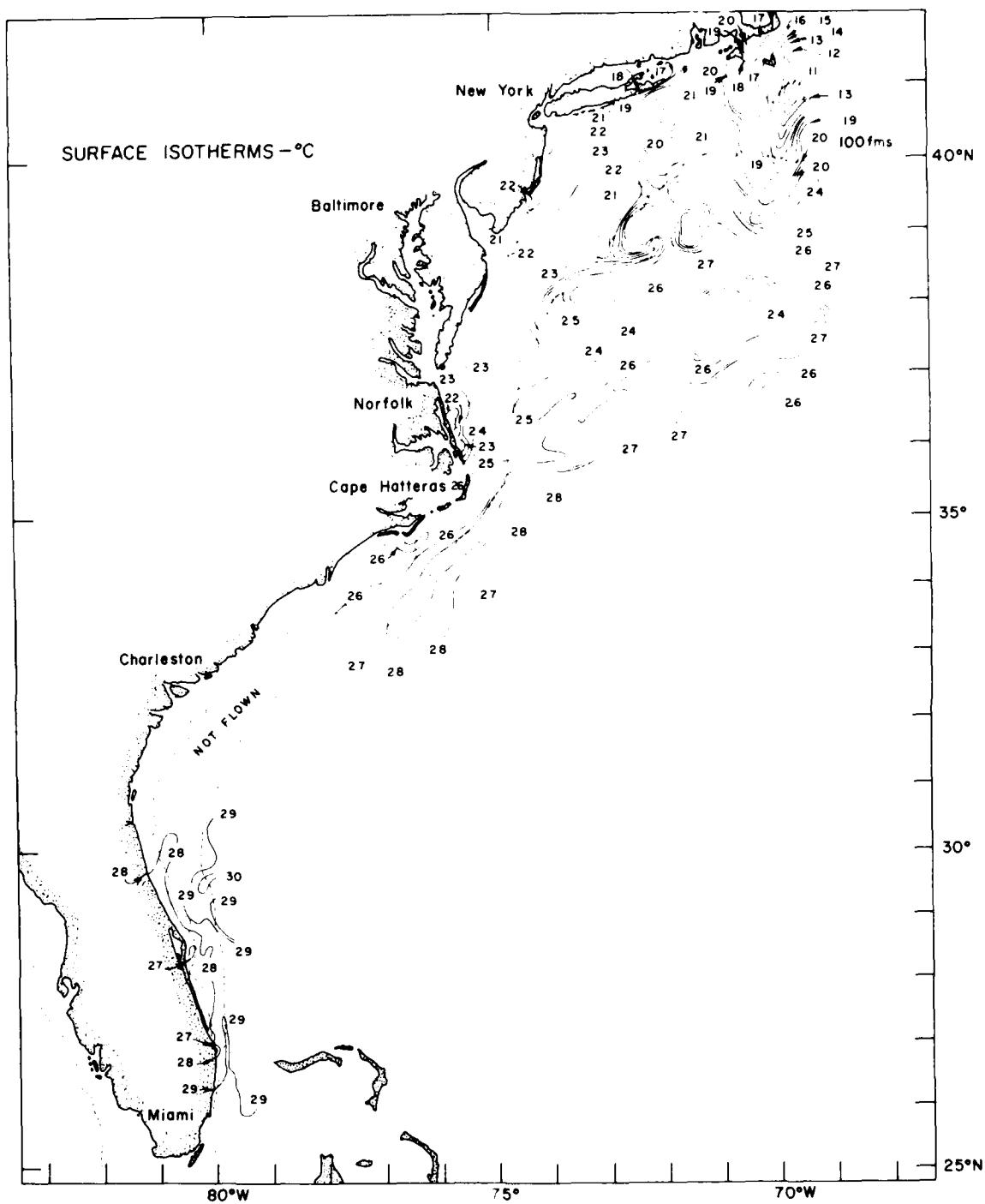


Figure 38. Monthly surface isotherm chart, 17-19, 21 July 1973

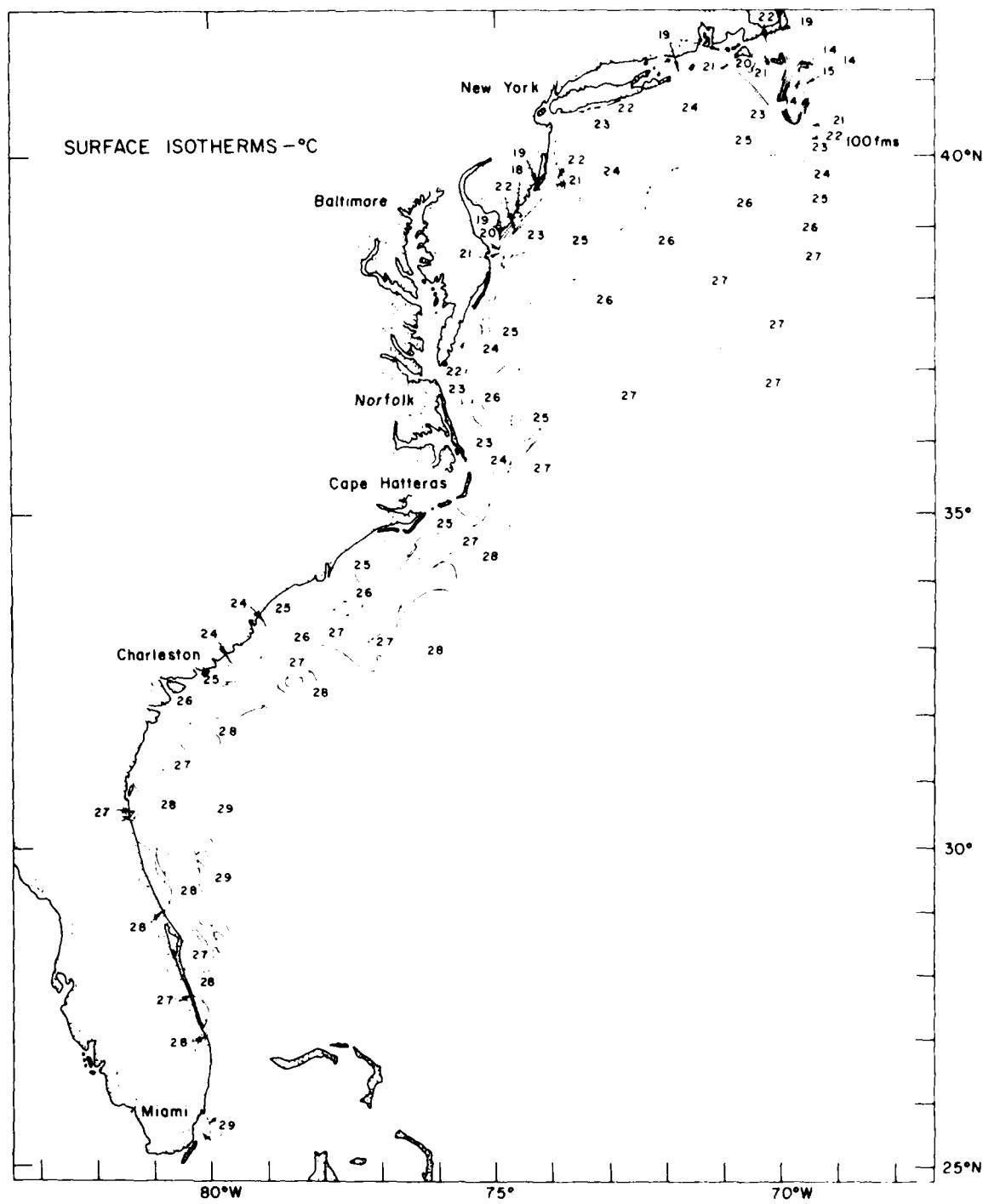


Figure 39. Monthly surface isotherm chart, 14, 16, 20-23 August 1973

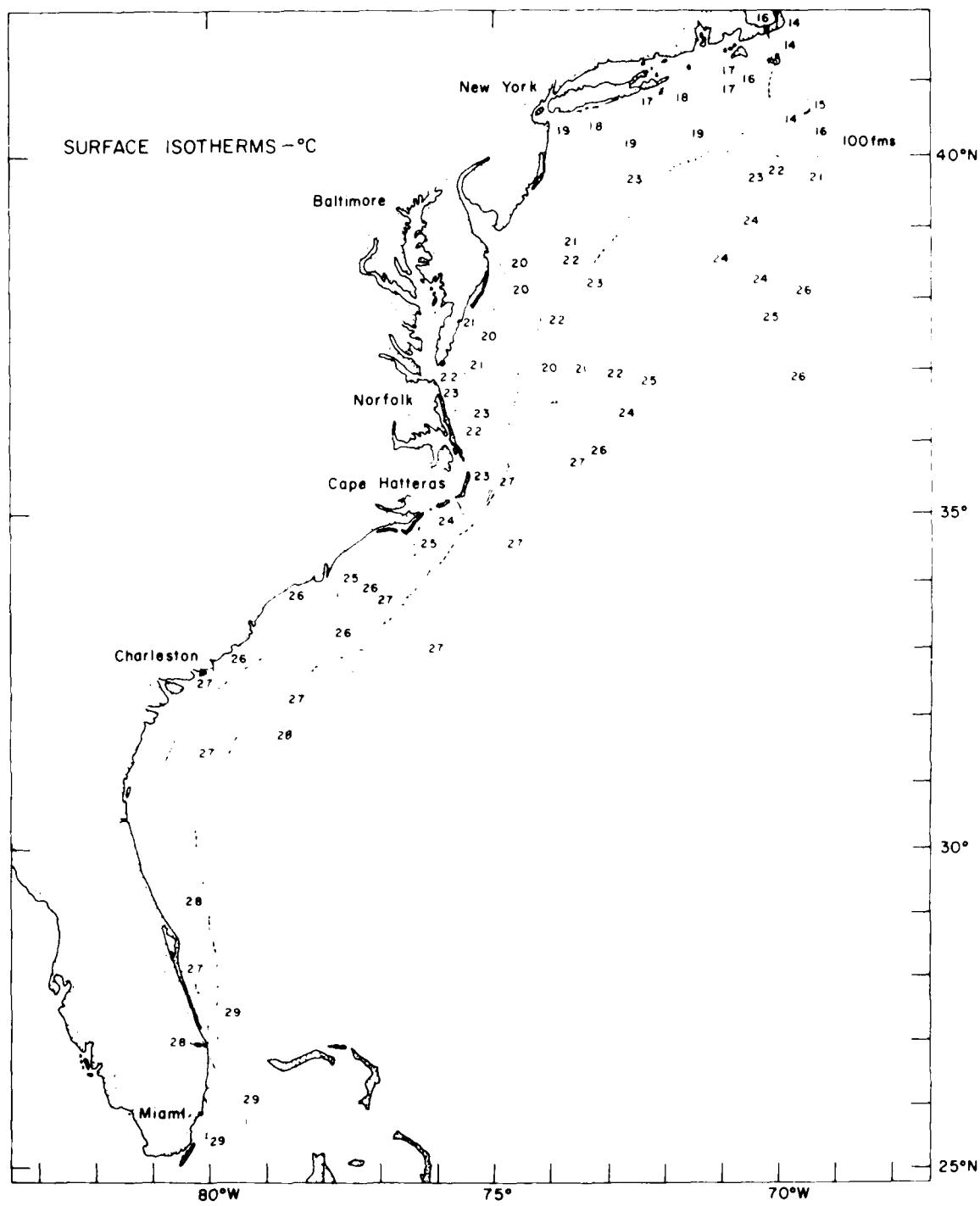


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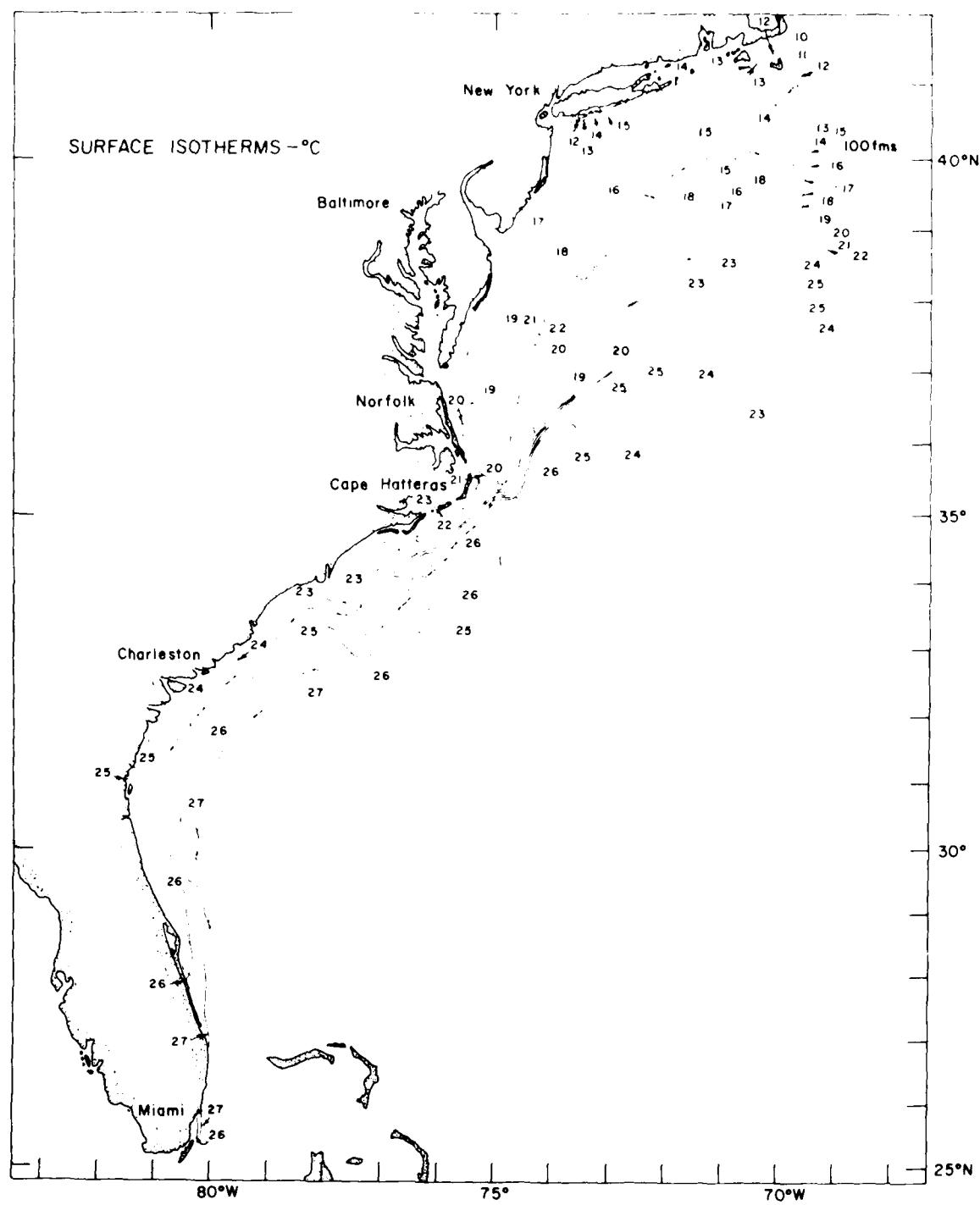


Figure 41. Monthly surface isotherm chart, 15-19 October 1973

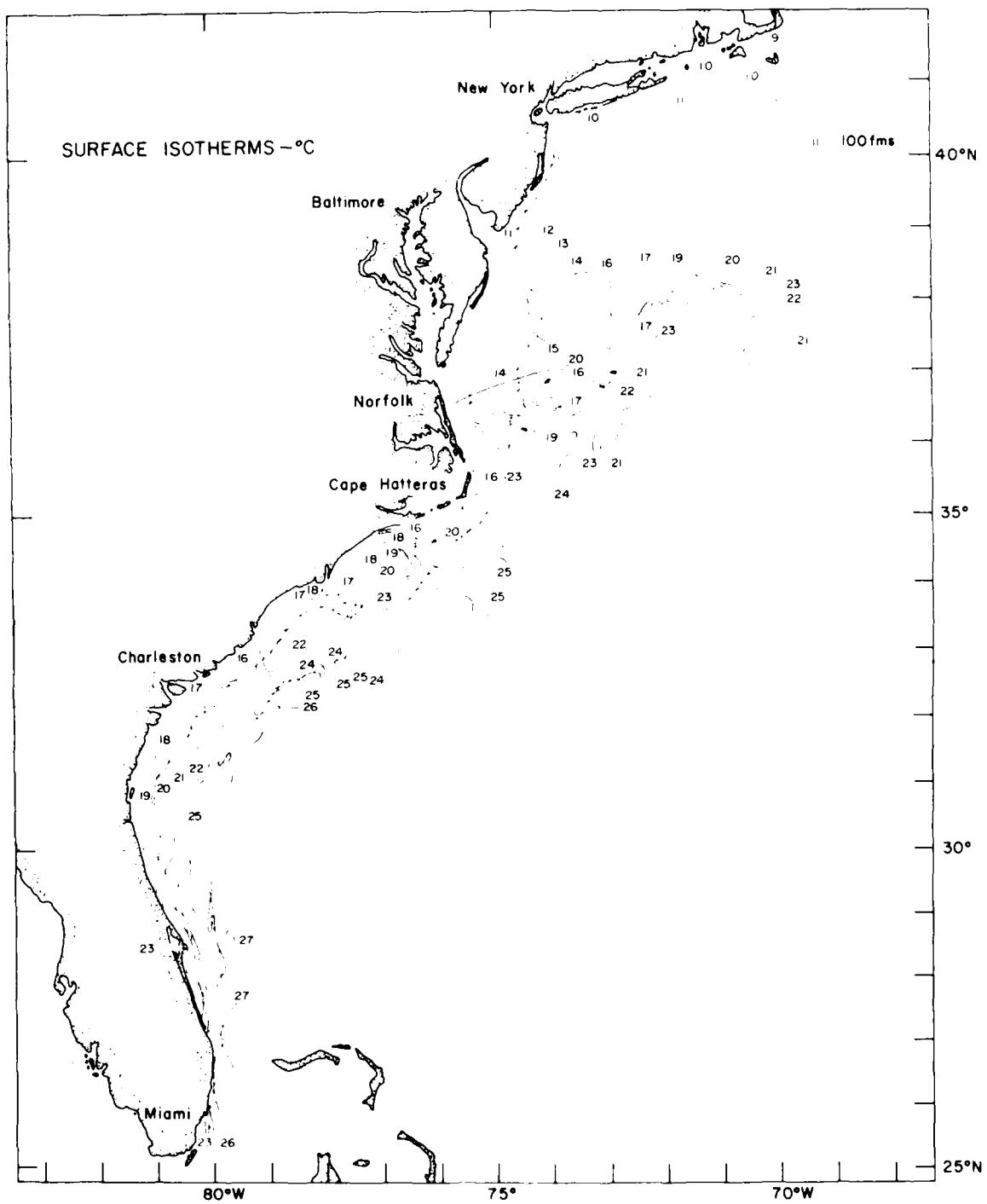


Figure 42. Monthly surface isotherm chart, 12-16 November 1973

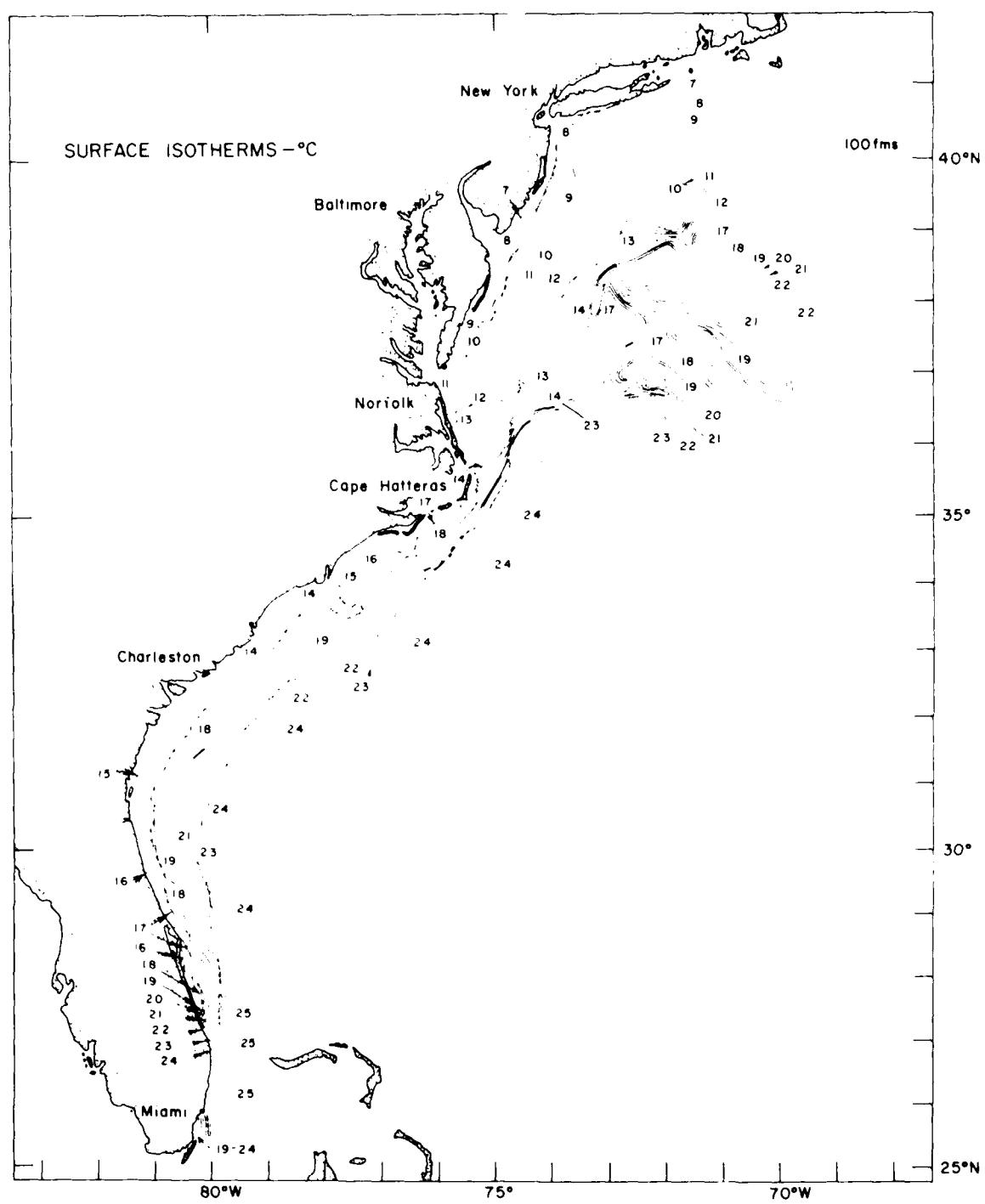


Figure 43. Monthly surface isotherm chart, 10-13 December 1973

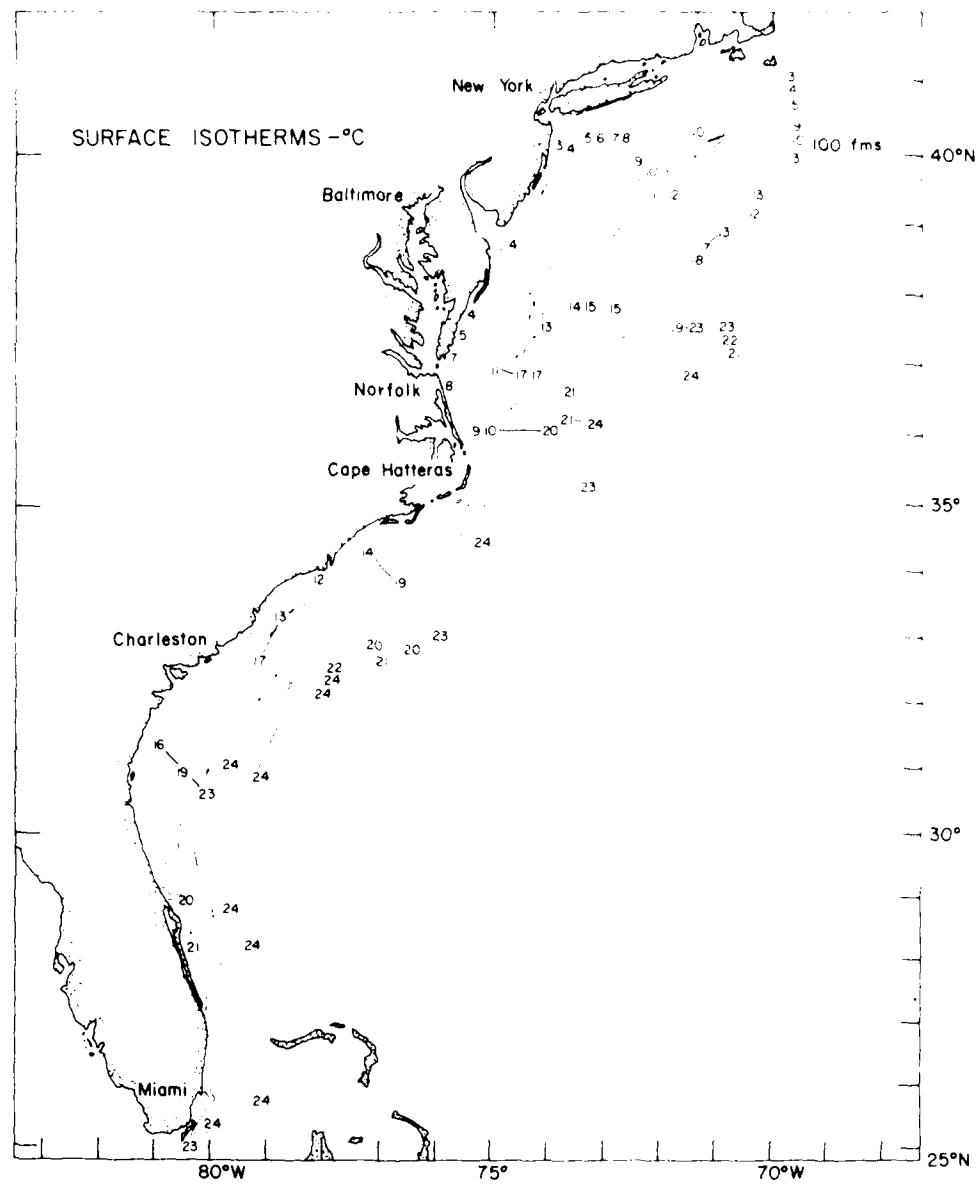


Figure 44. Monthly surface isotherm chart, 14, 16-18, 21 January 1974

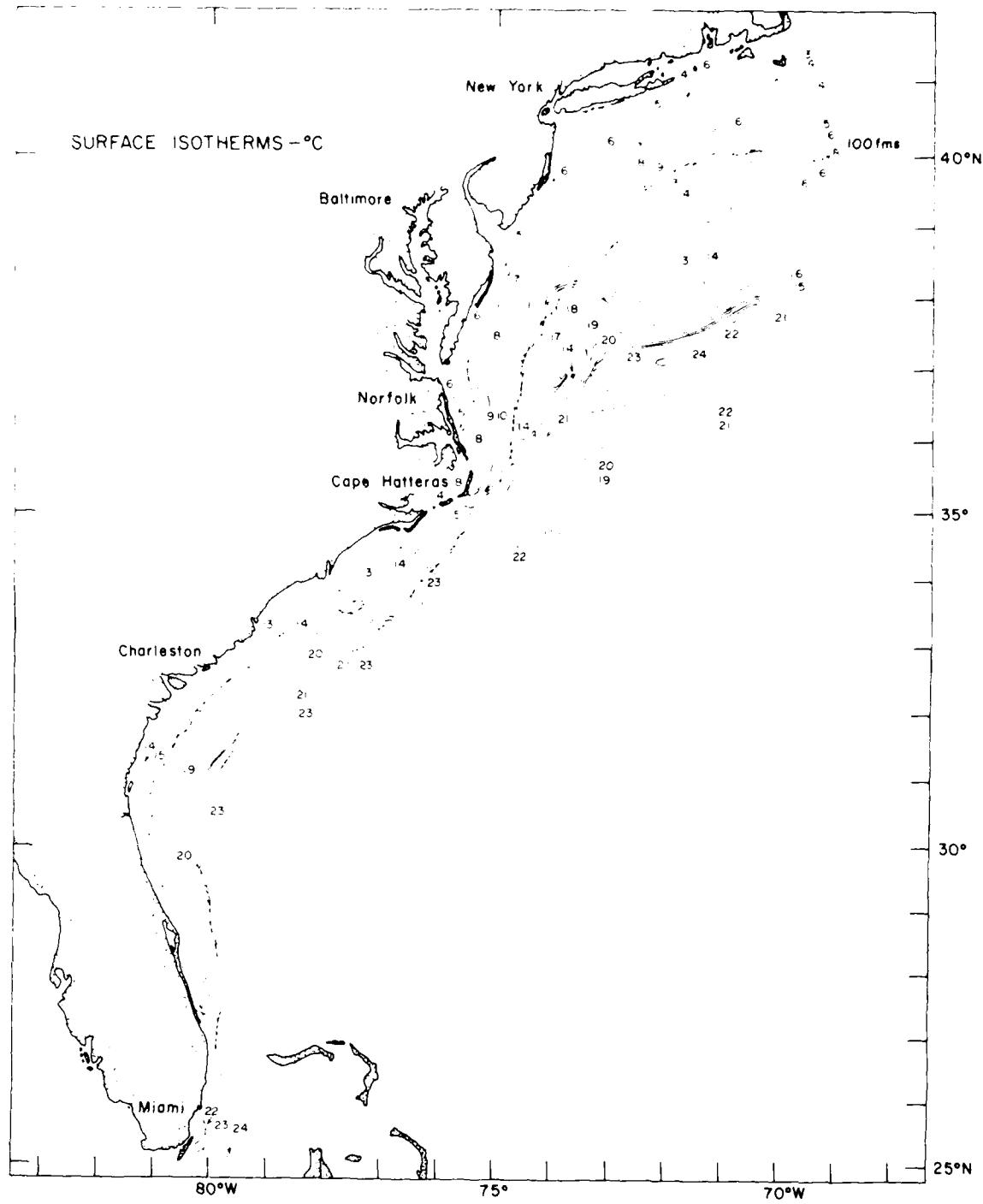


Figure 45. Monthly surface isotherm chart, 12-14 February 1974

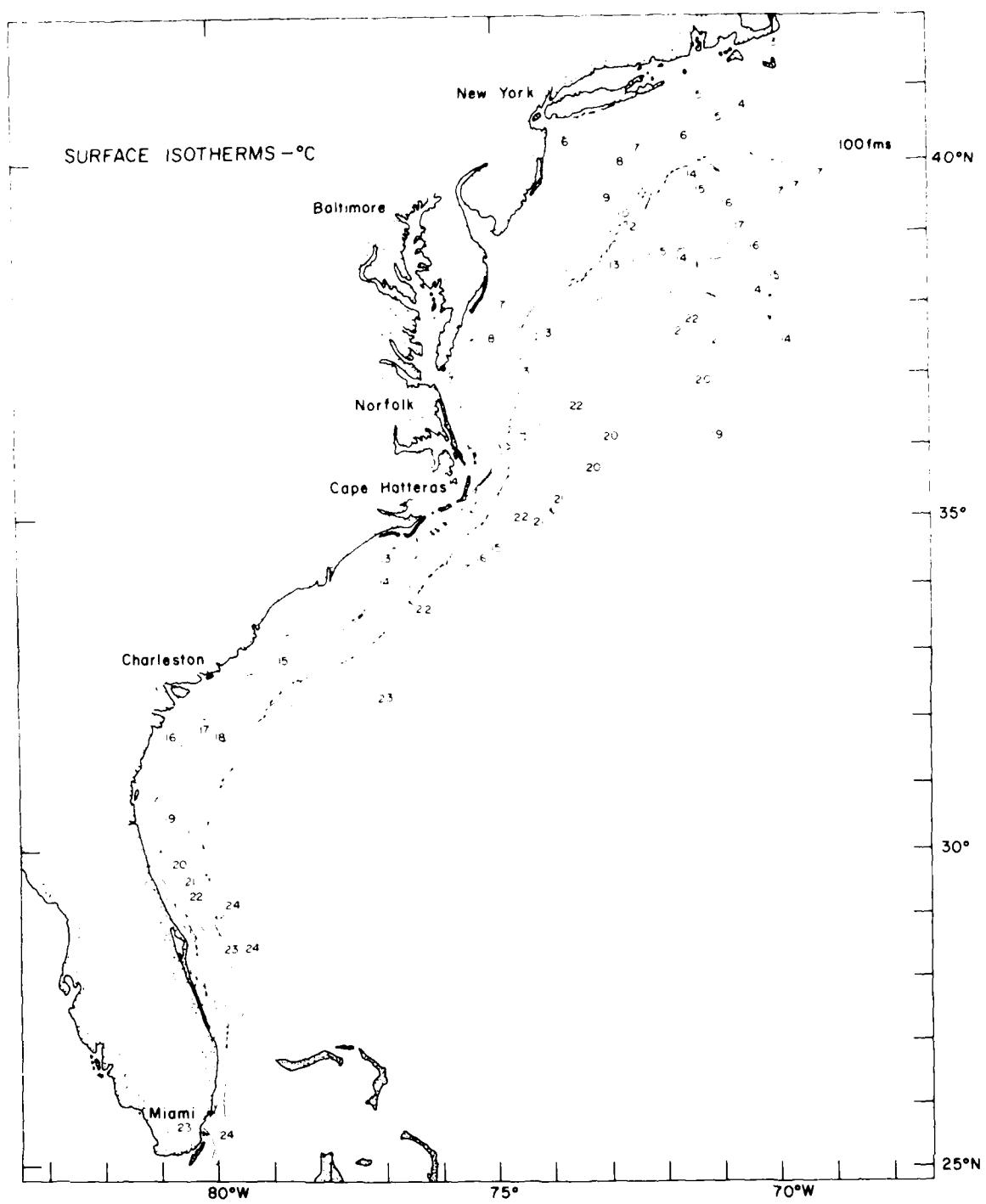


Figure 46. Monthly surface isotherm chart, 19, 20, 22 March 1974

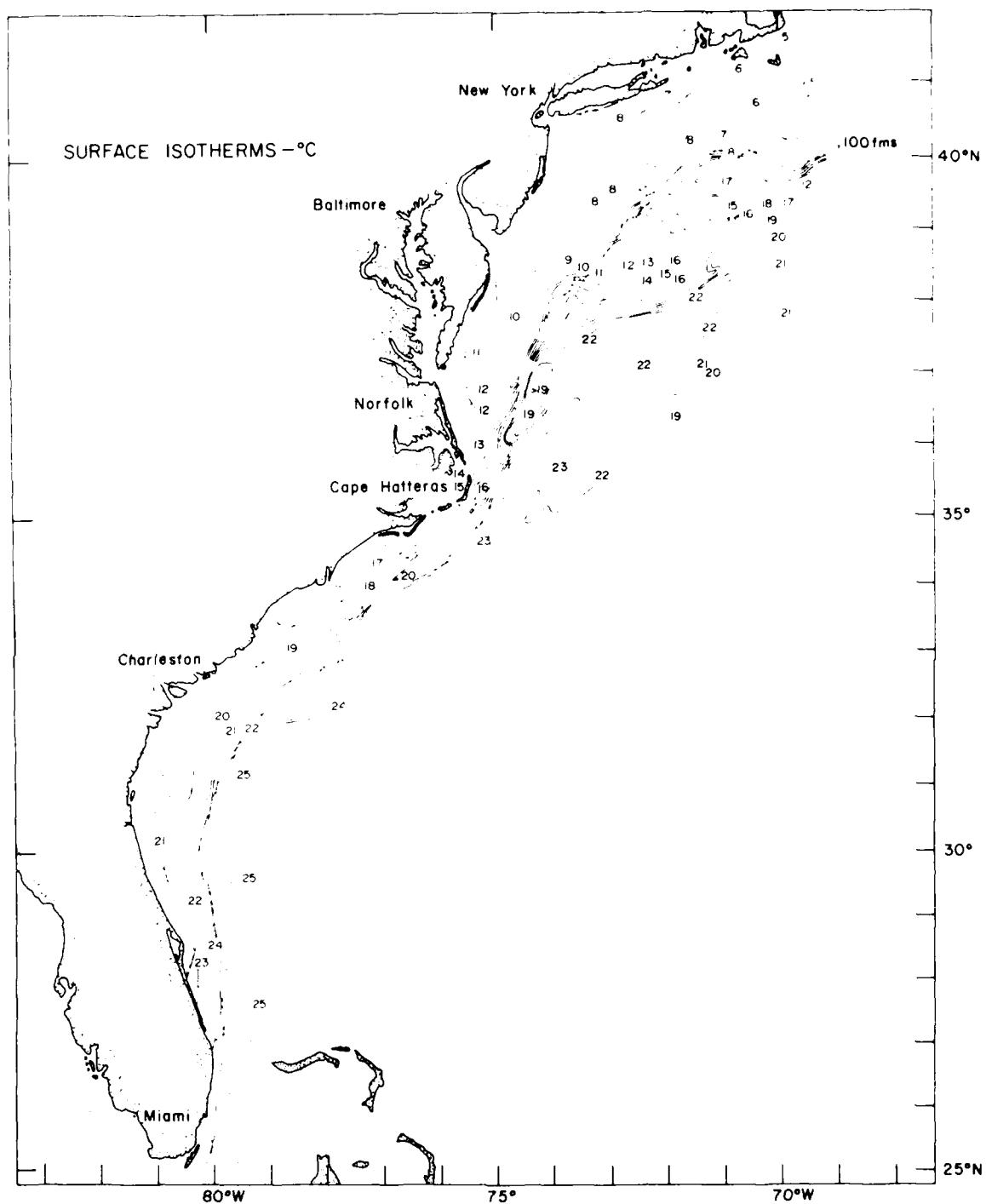


Figure 47. Monthly surface isotherm chart, 22-24, 26 April 1974

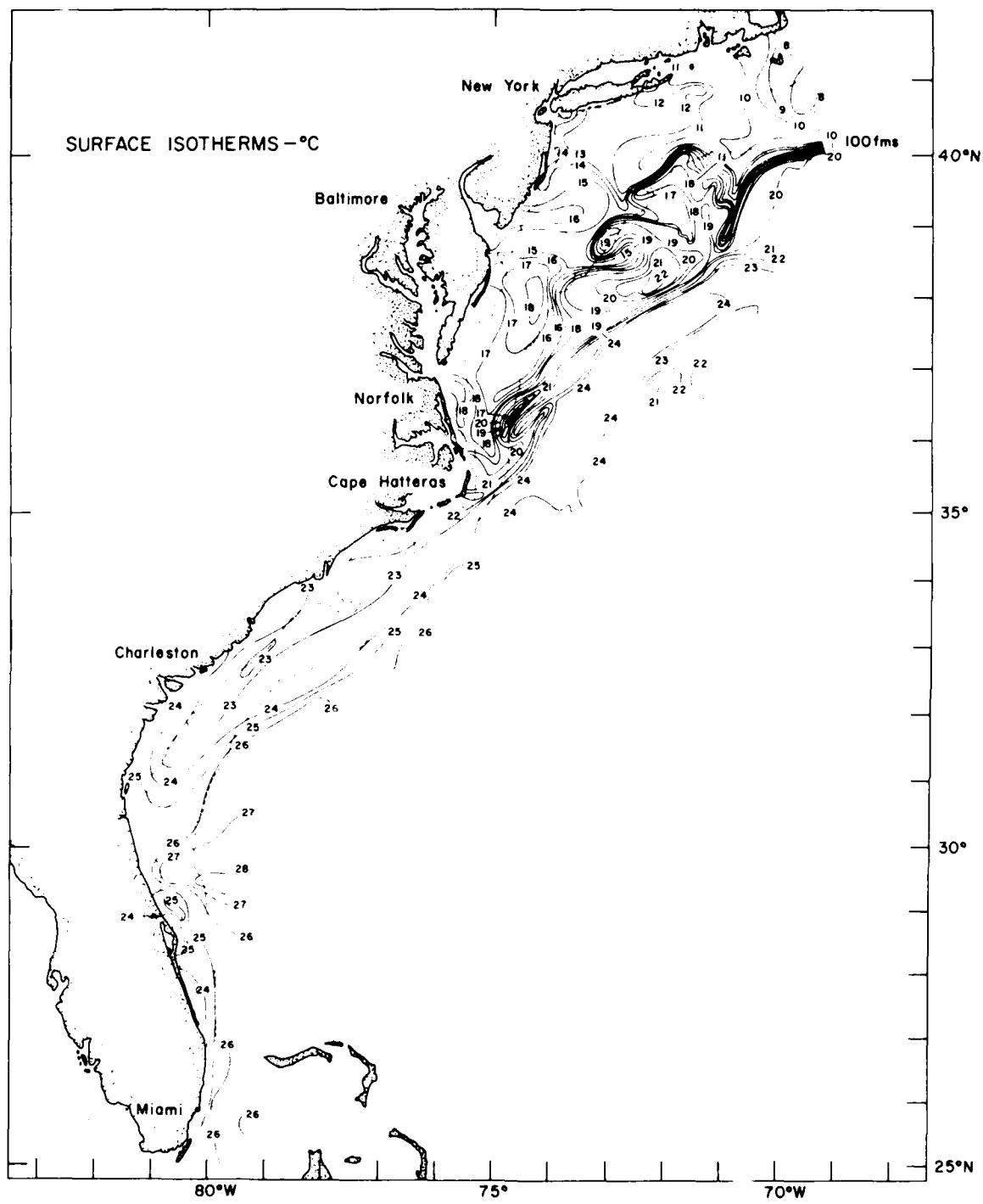


Figure 48. Monthly surface isotherm chart, 20-22 May 1974

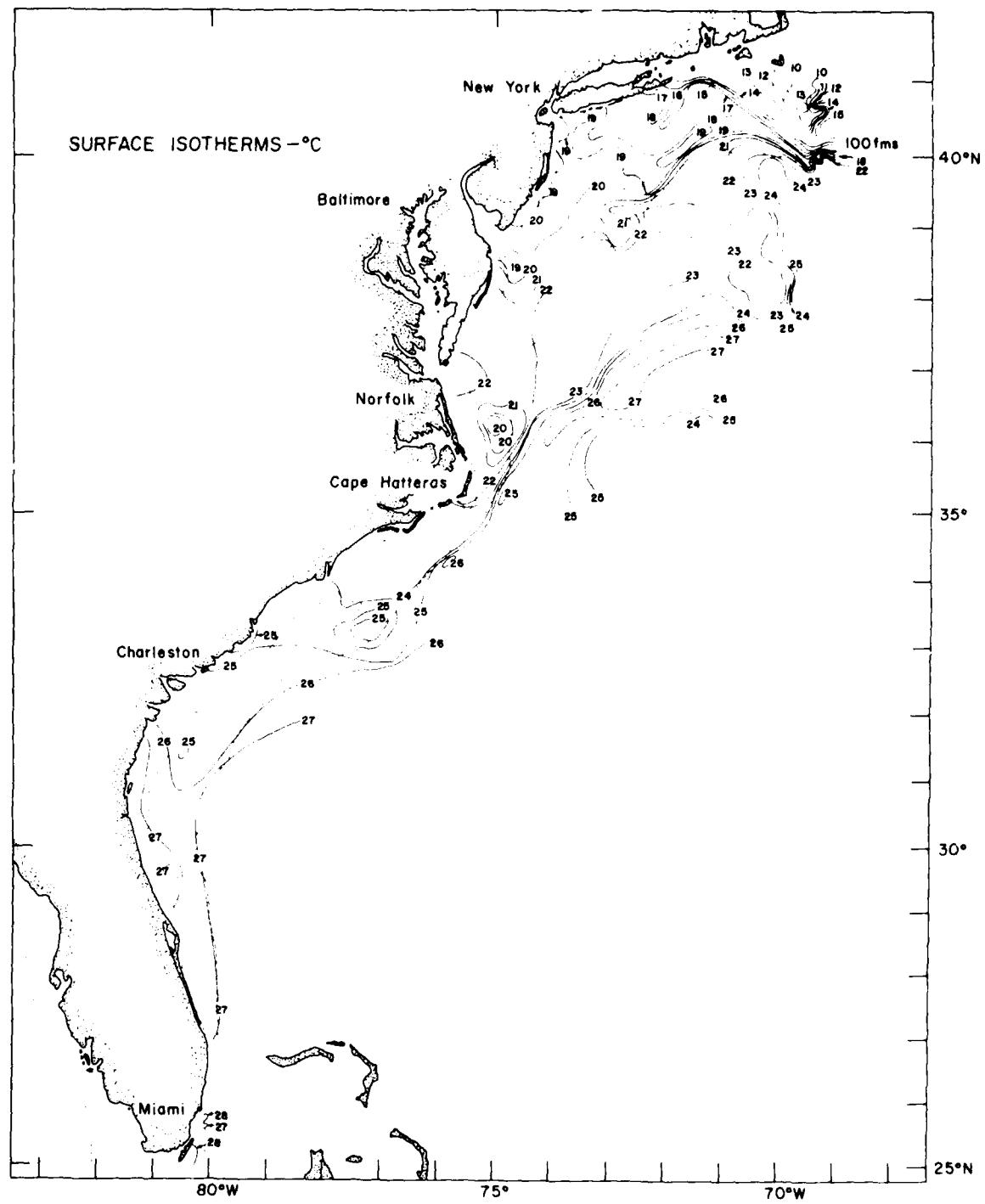


Figure 49. Monthly surface isotherm chart, 19-21 June 1974

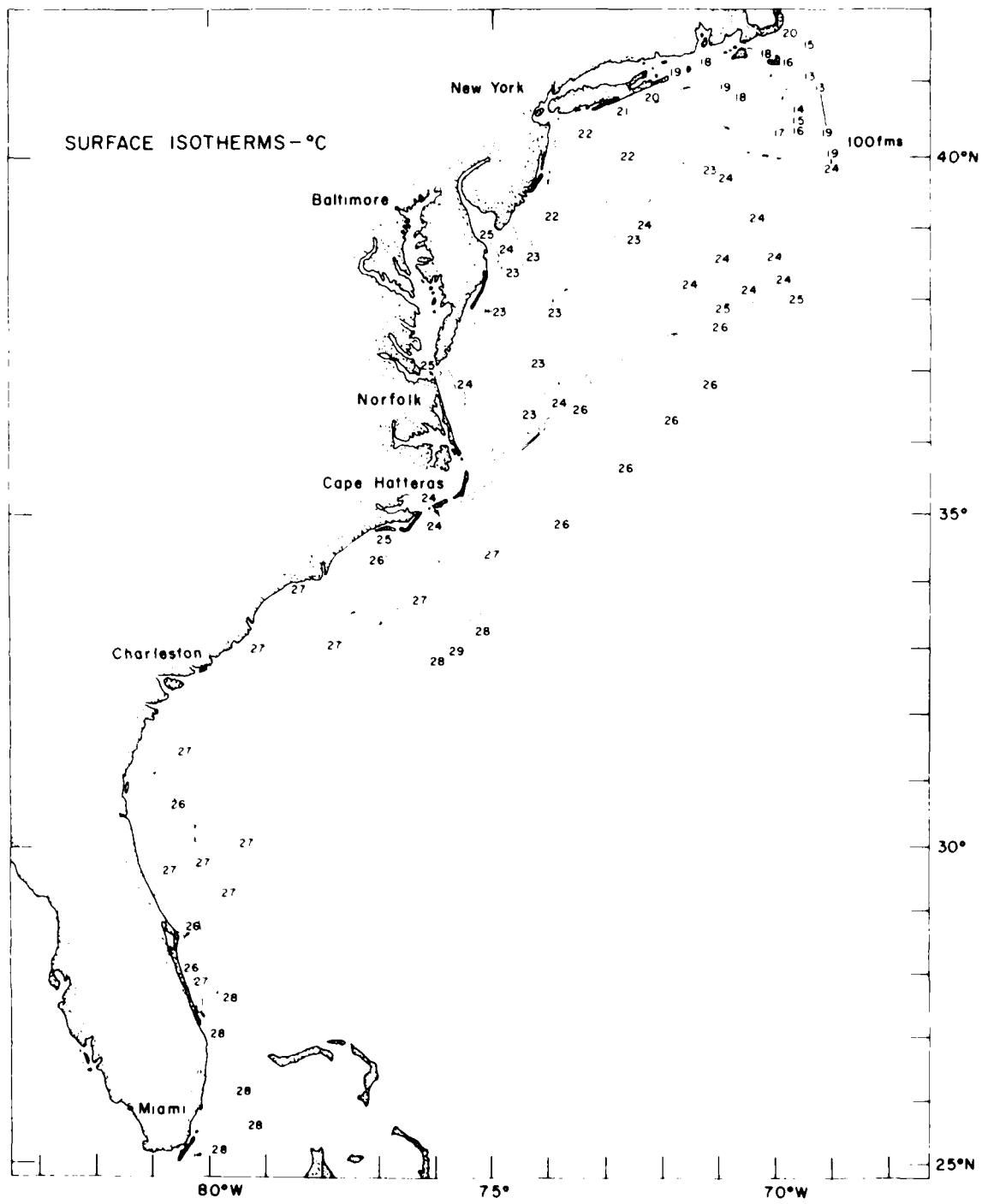


Figure 50. Monthly surface isotherm chart, 15-17 July 1974

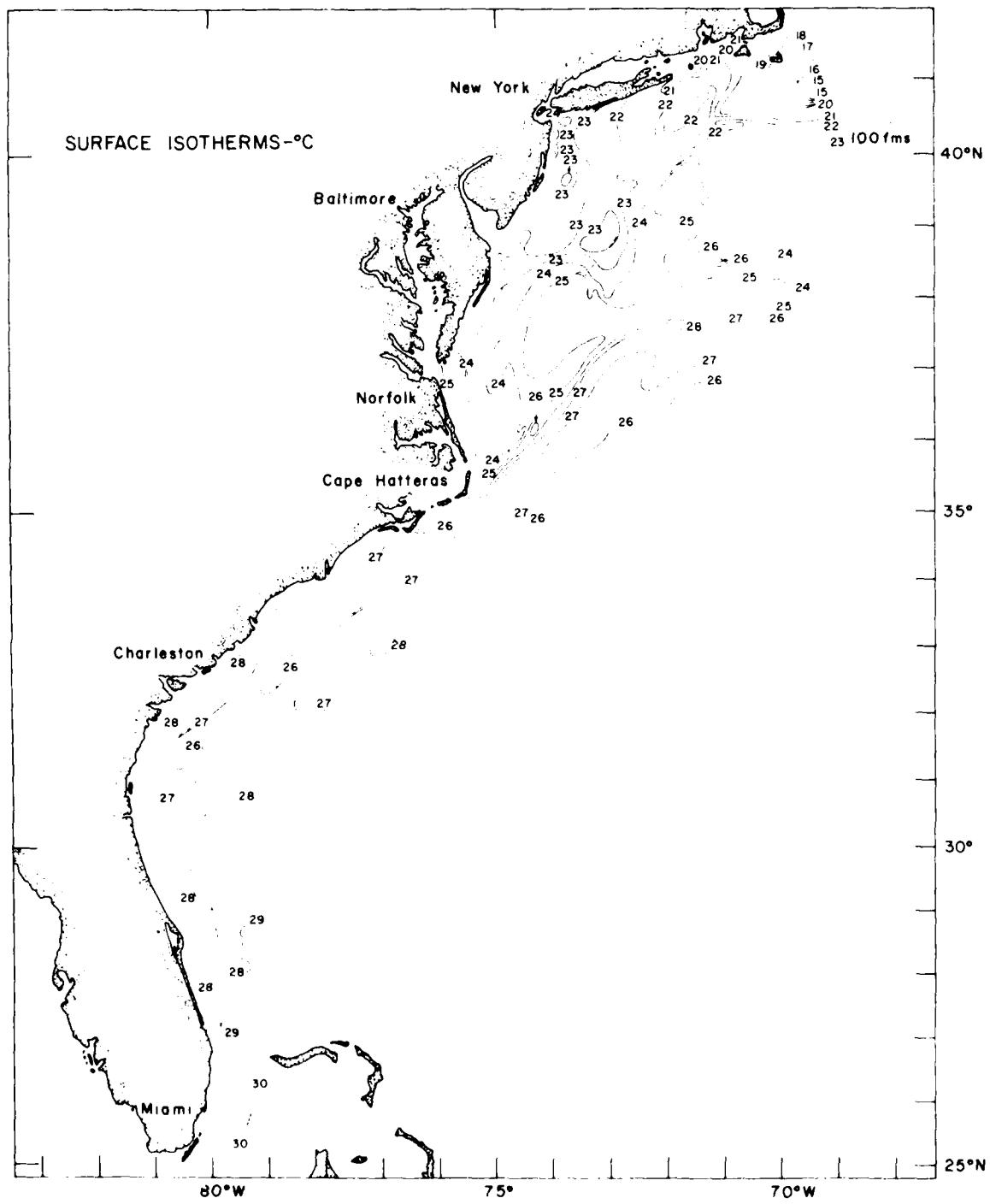


Figure 51. Monthly surface isotherm chart, 19-22 August 1974

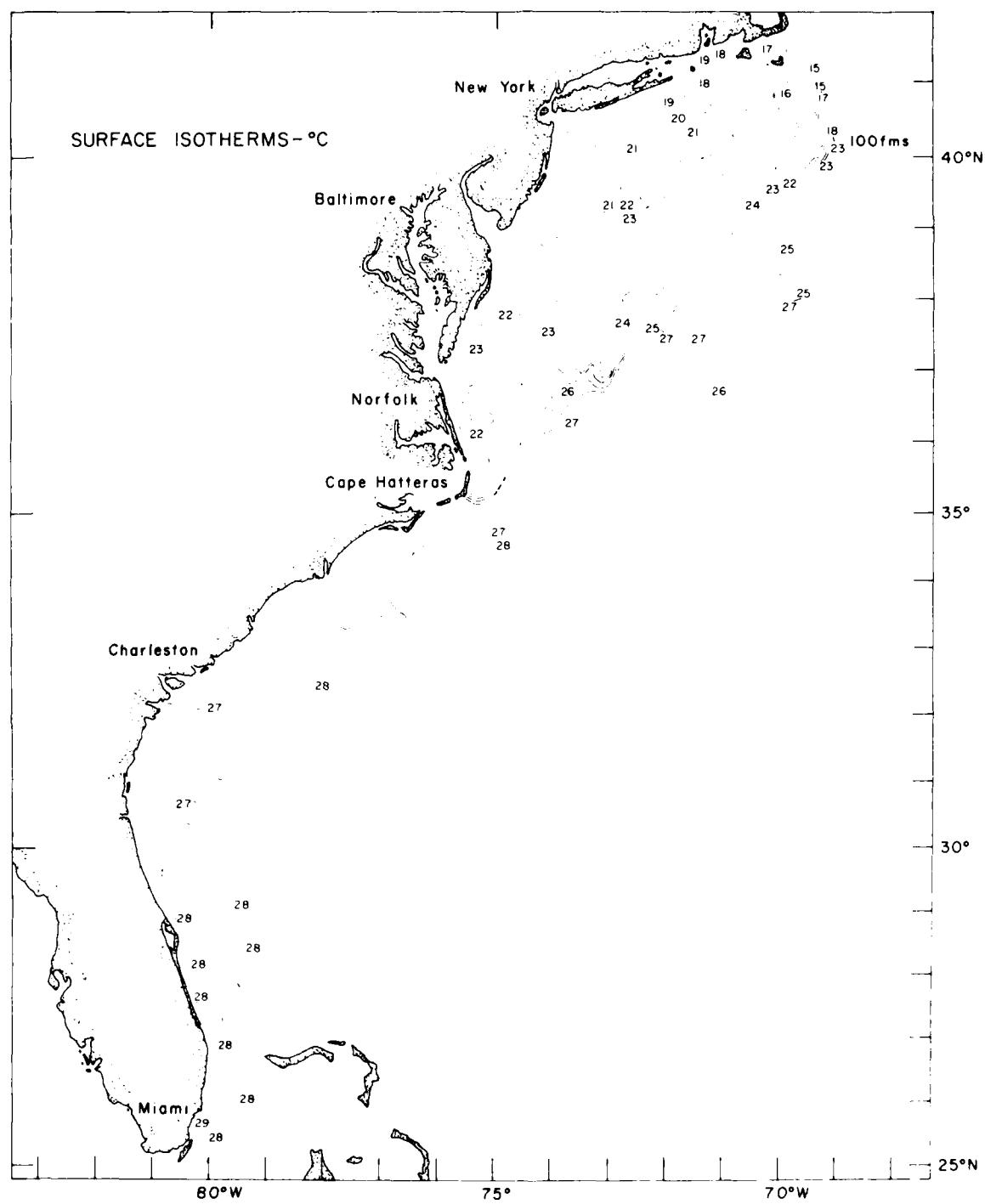


Figure 52. Monthly surface isotherm chart, 16-20, 23 September 1974

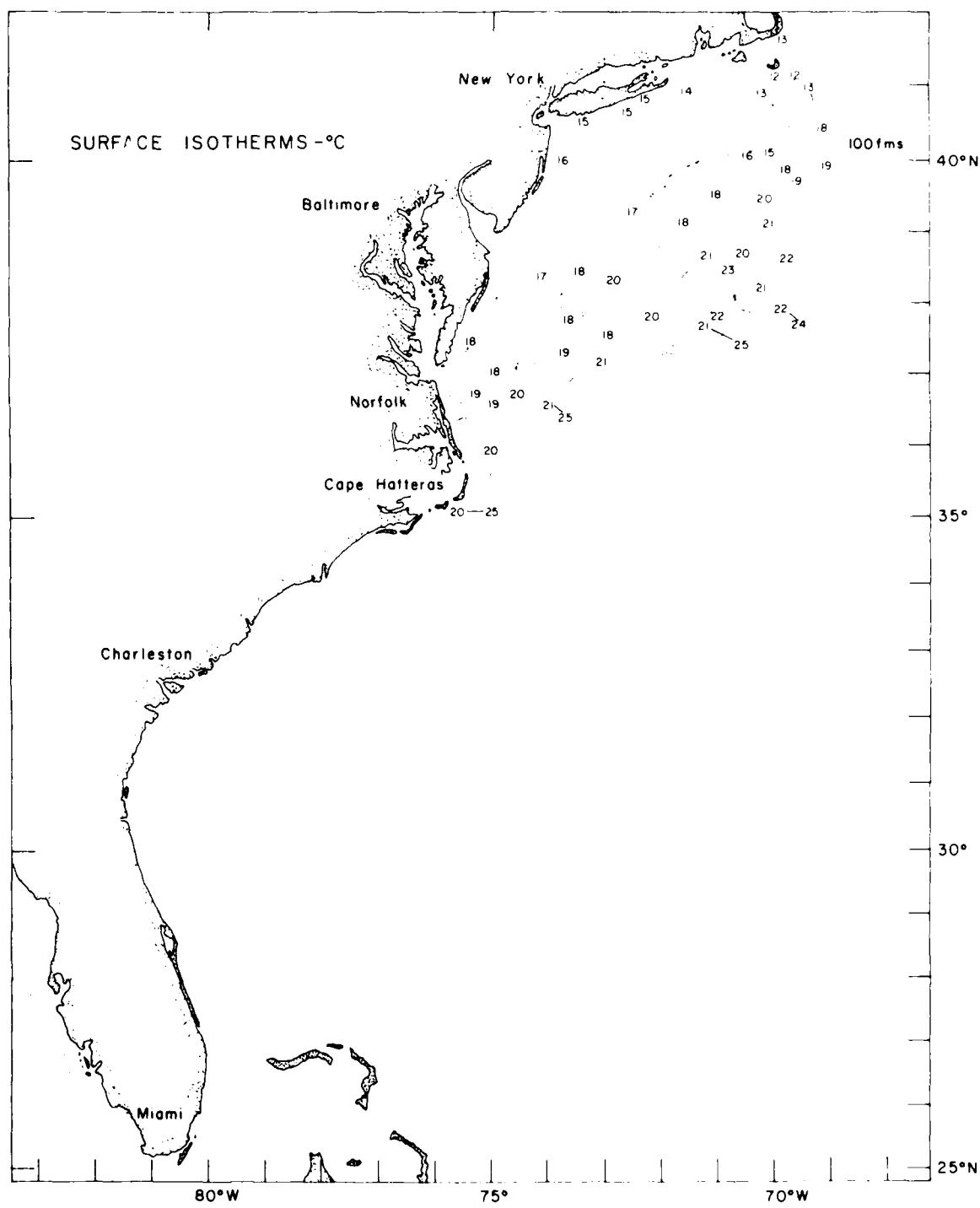


Figure 53. Monthly surface isotherm chart, 15, 17, 18 October 1974

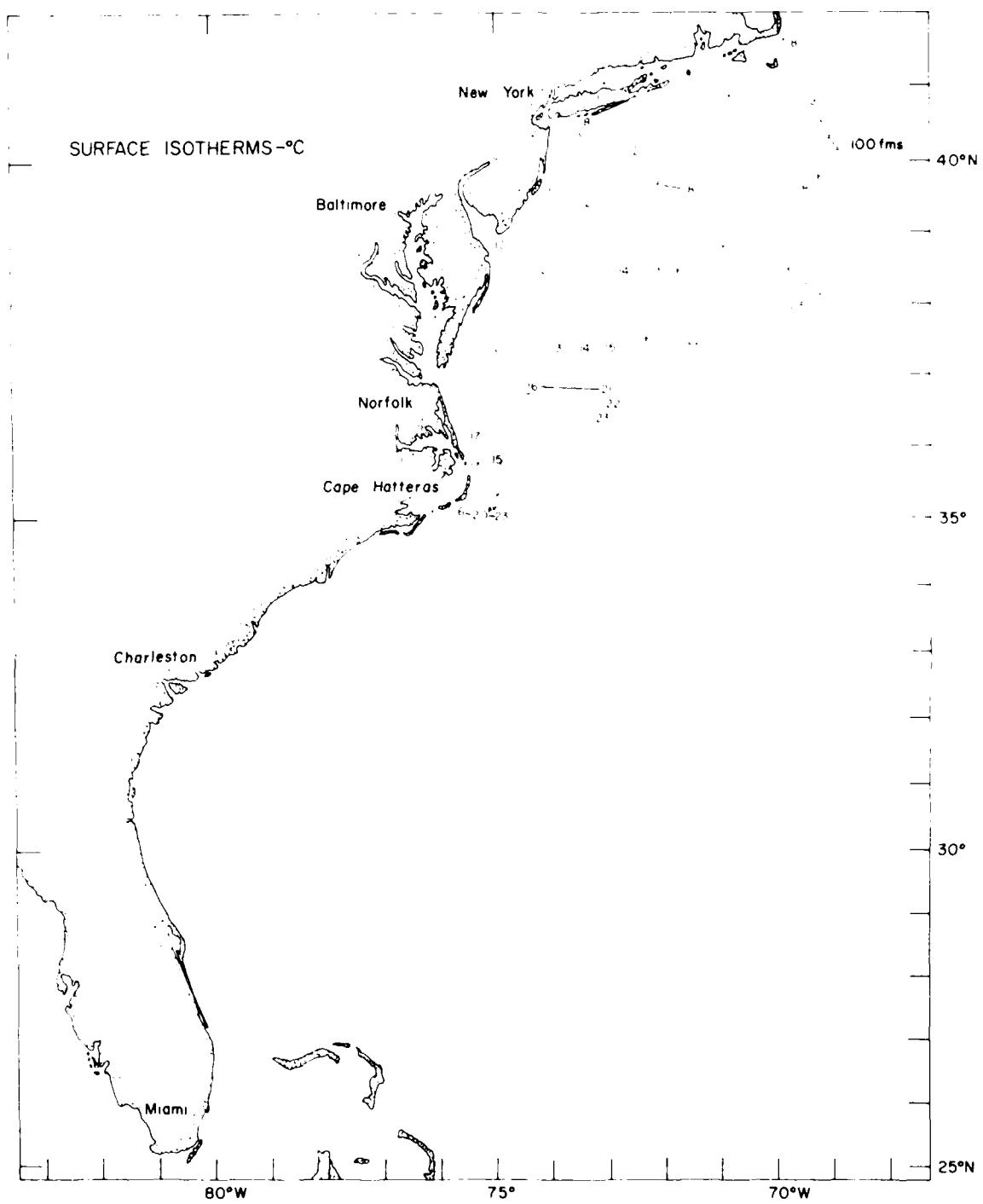


Figure 54. Monthly surface isotherm chart, 19, 22, 23 November 1974

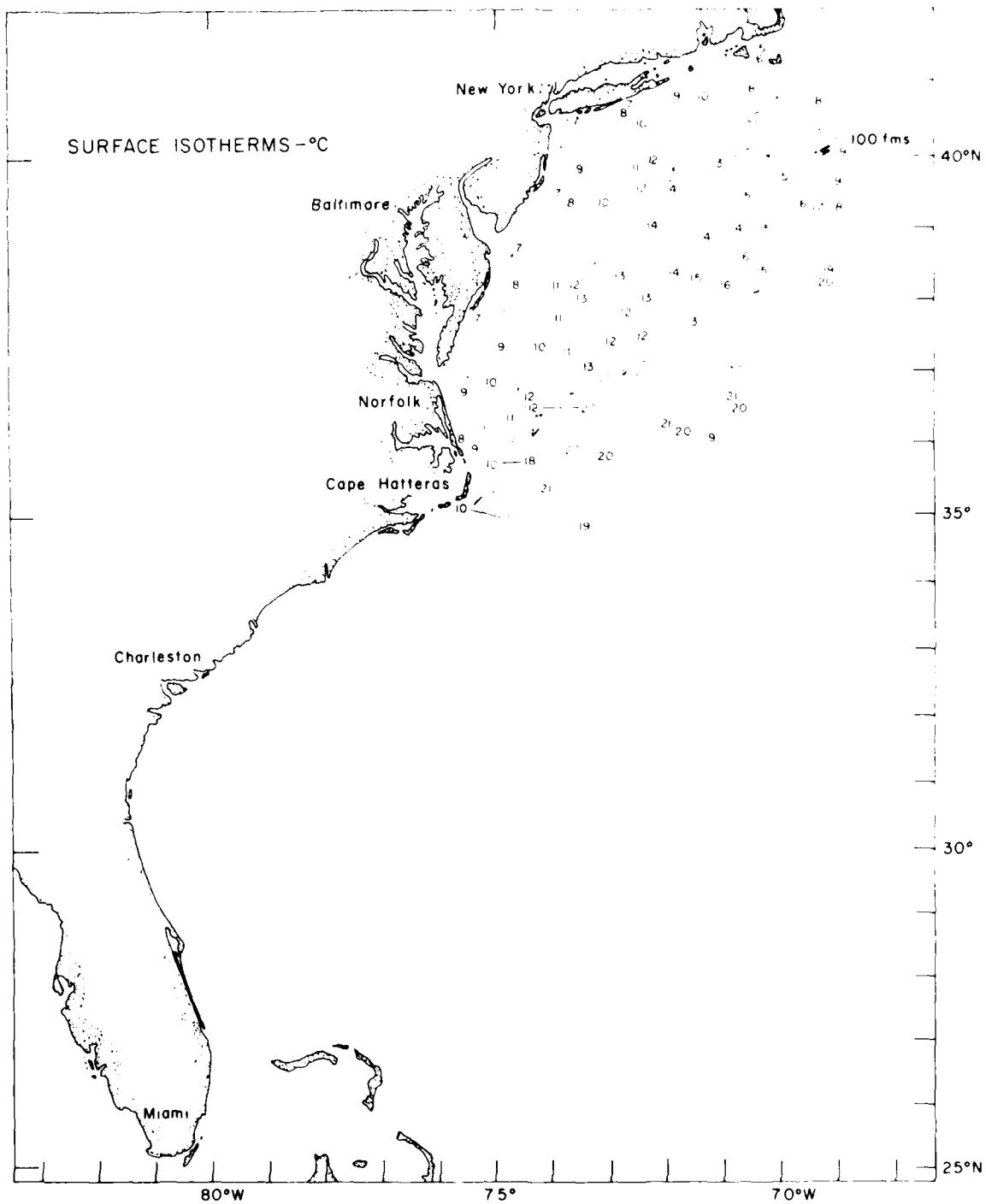


Figure 55. Monthly surface isotherm chart, 10-12 December 1974

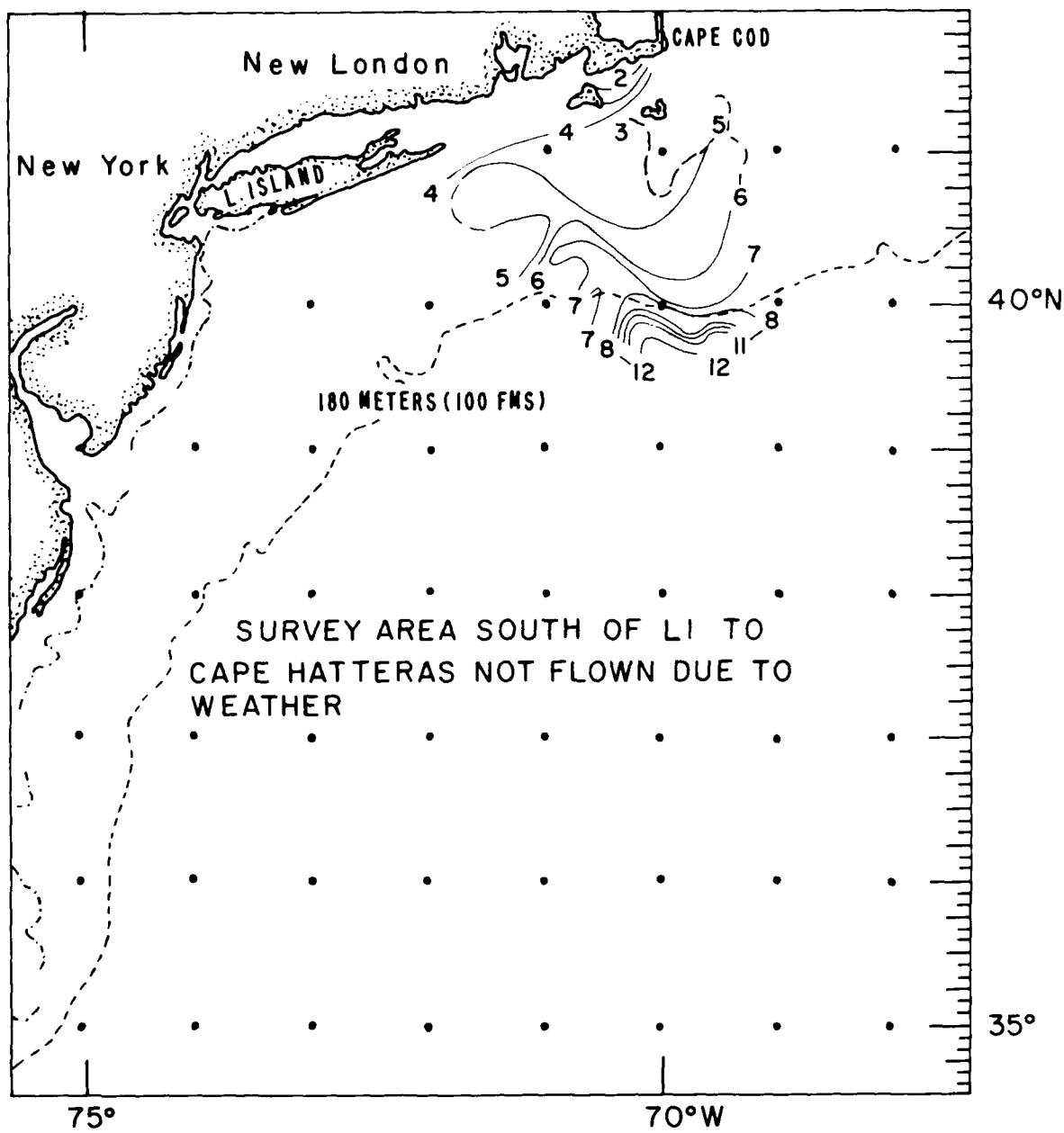


Figure 56. Monthly surface isotherm chart, 1 February 1975

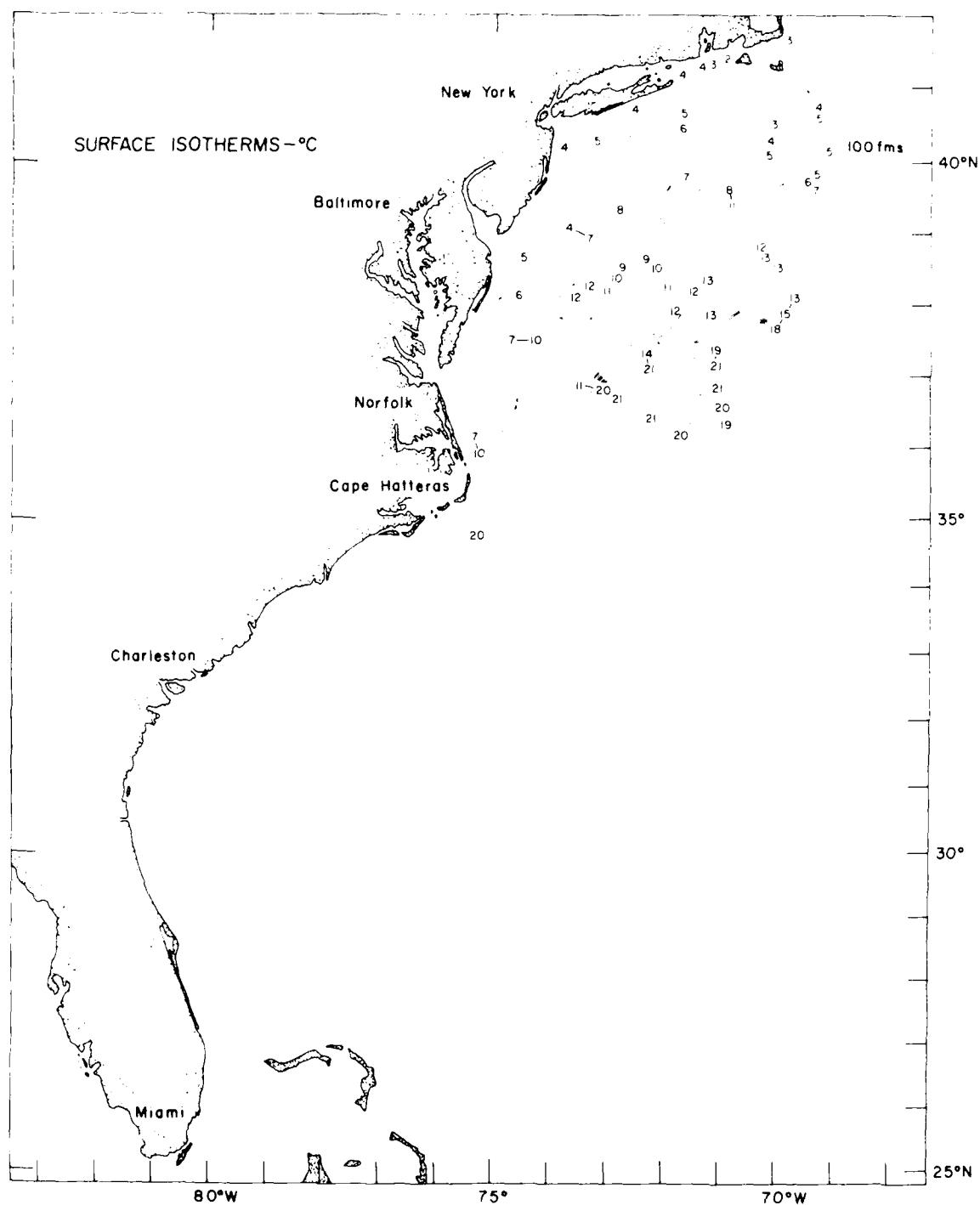


Figure 57. Monthly surface isotherm chart, 27, 28 February 1975

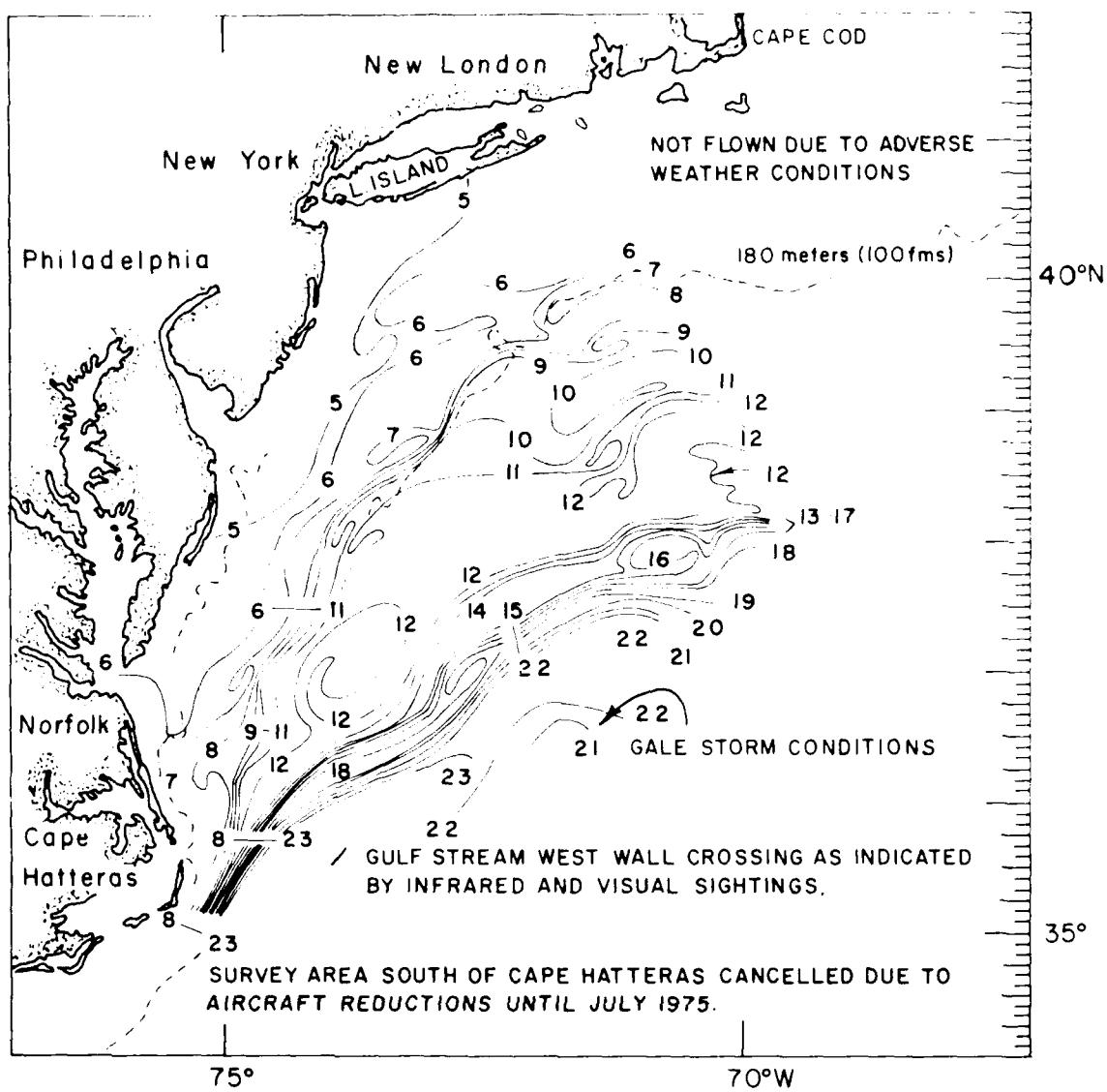


Figure 58. Monthly surface isotherm chart, 18, 20 March 1975

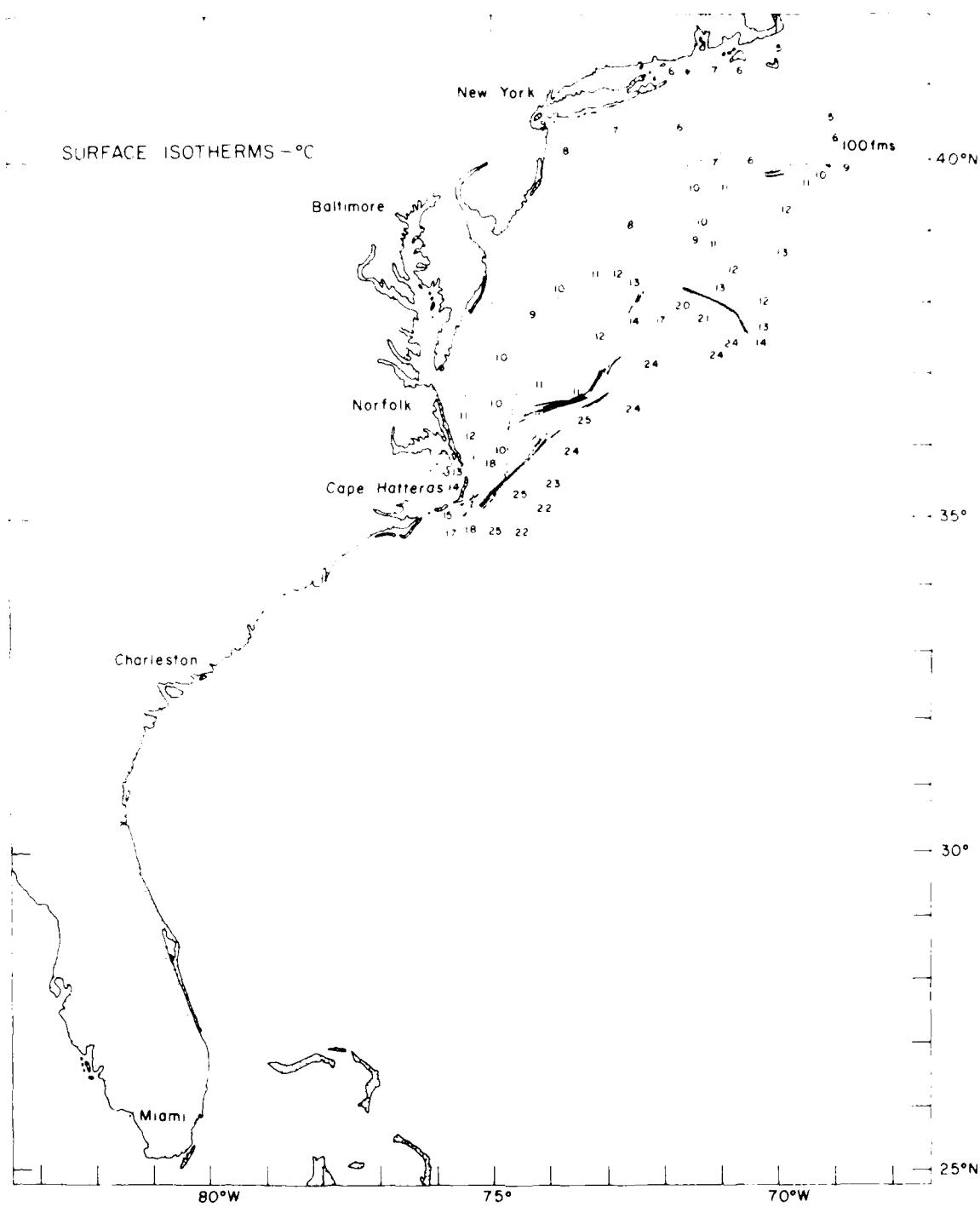


Figure 59. Monthly surface isotherm chart, 29, 30 April–2 May 1975

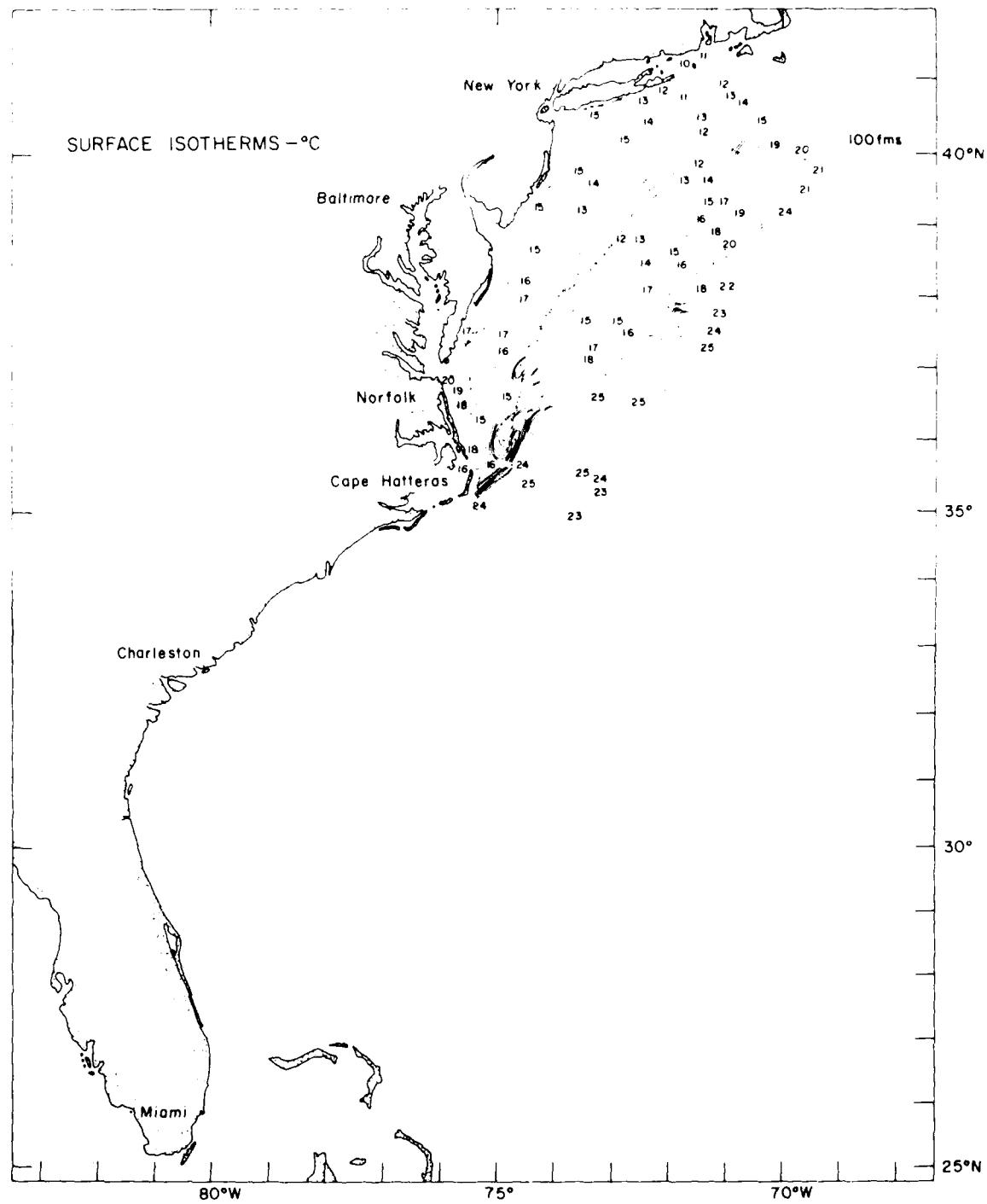


Figure 60. Monthly surface isotherm chart, 20-22 May 1975

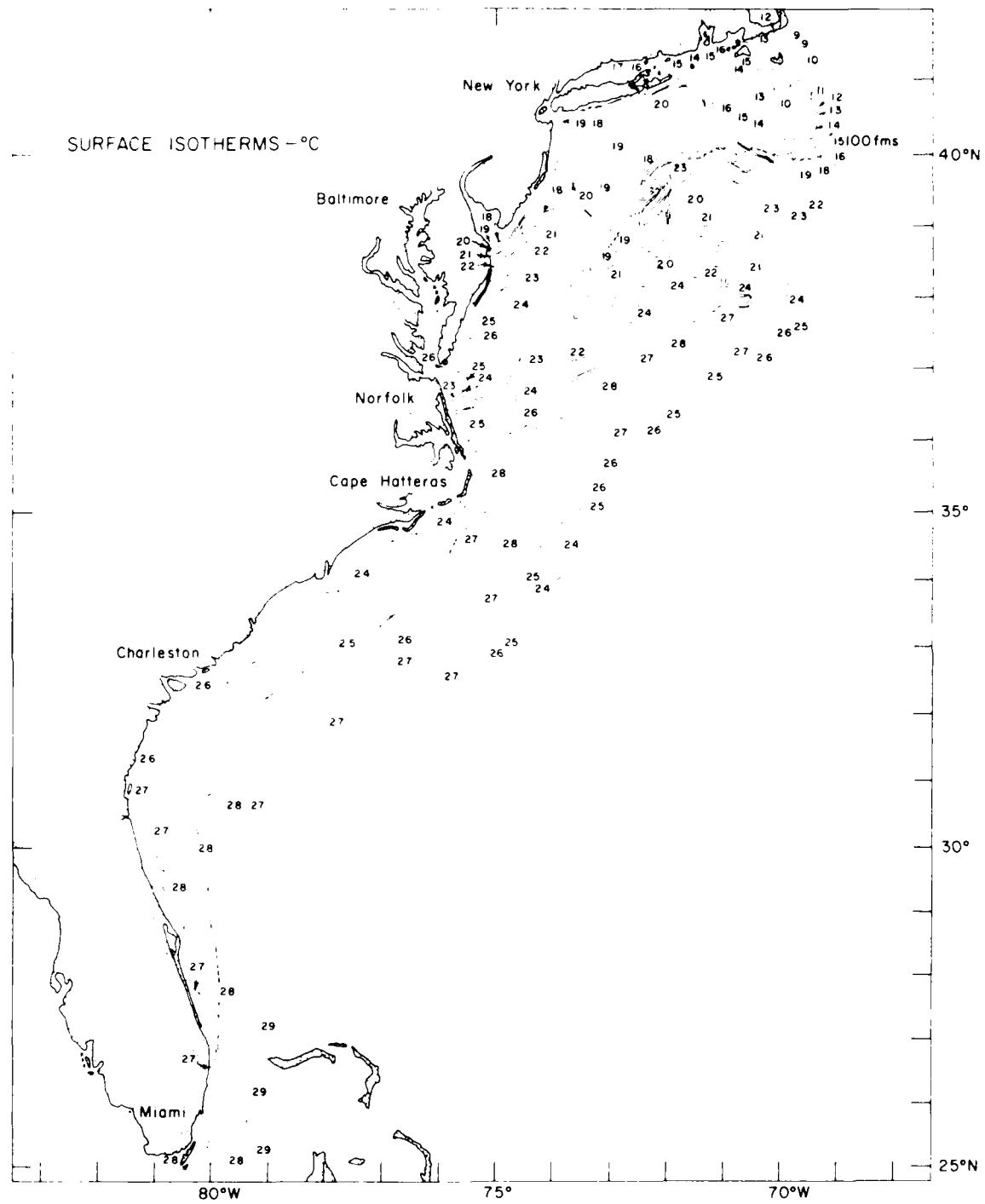


Figure 61. Monthly surface isotherm chart, 10-12, 18-20 June 1975

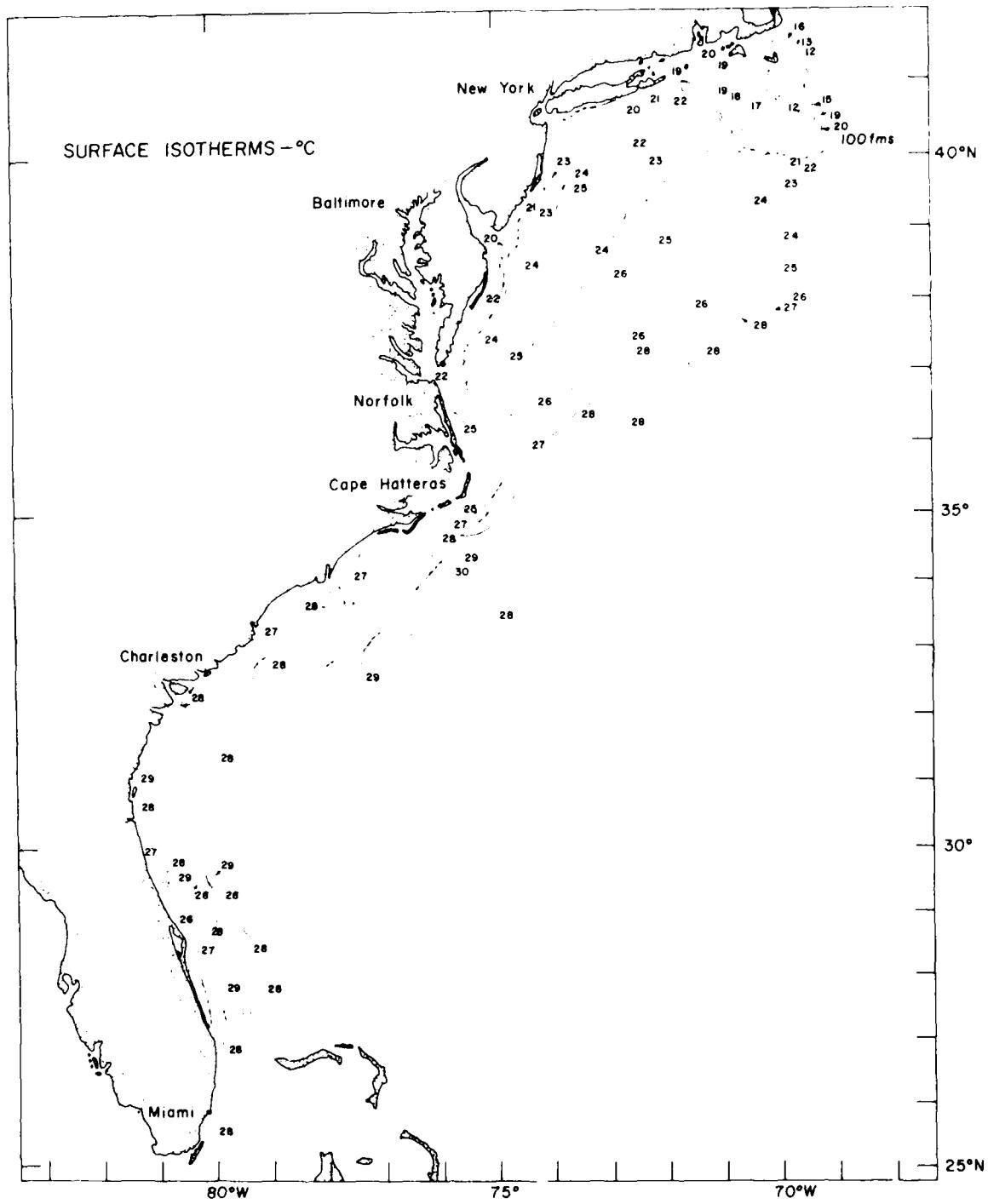


Figure 62. Monthly surface isotherm chart, 22, 24, 25, 29-31 July 1975

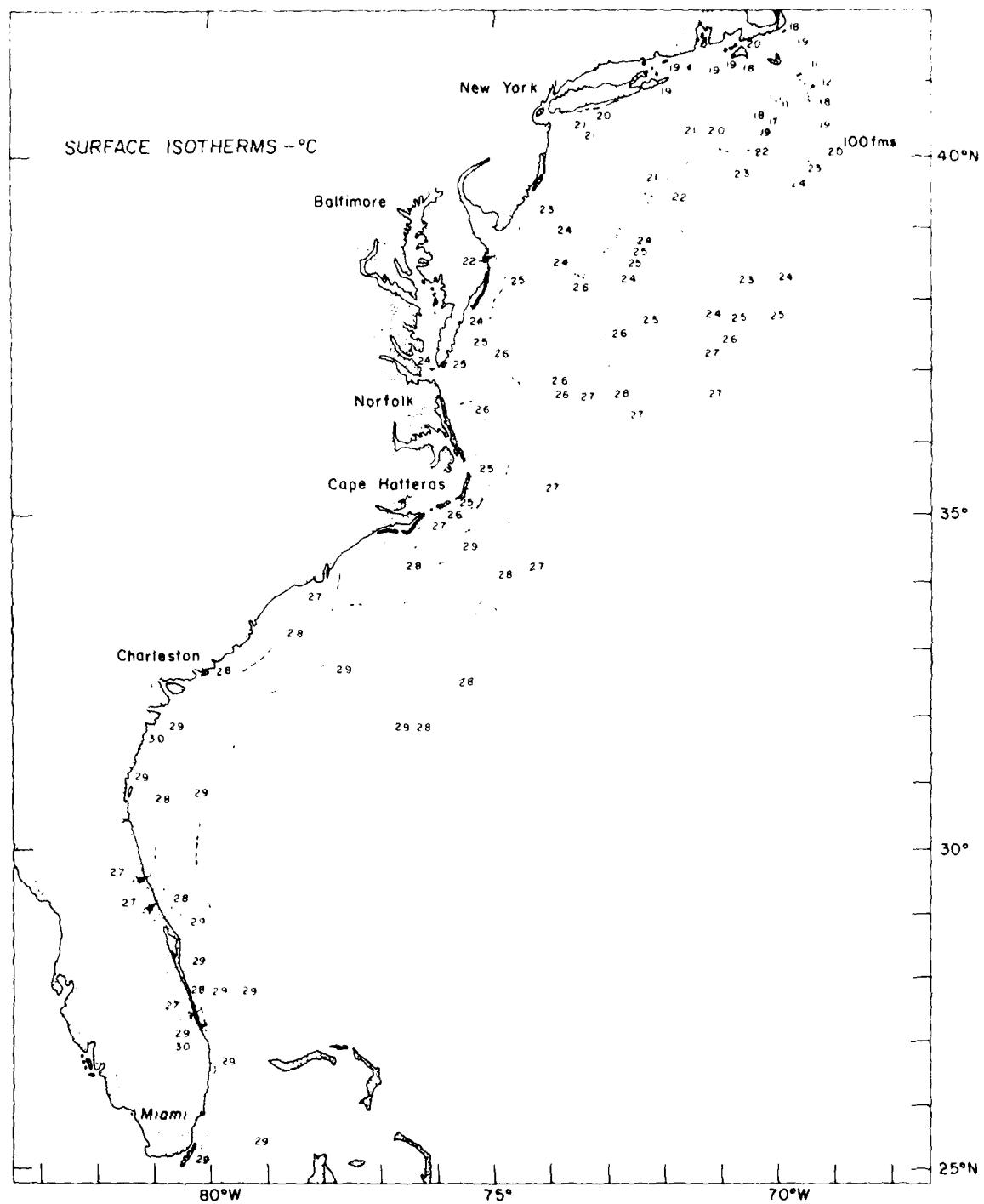


Figure 63. Monthly surface isotherm chart, 19-21 August 1975

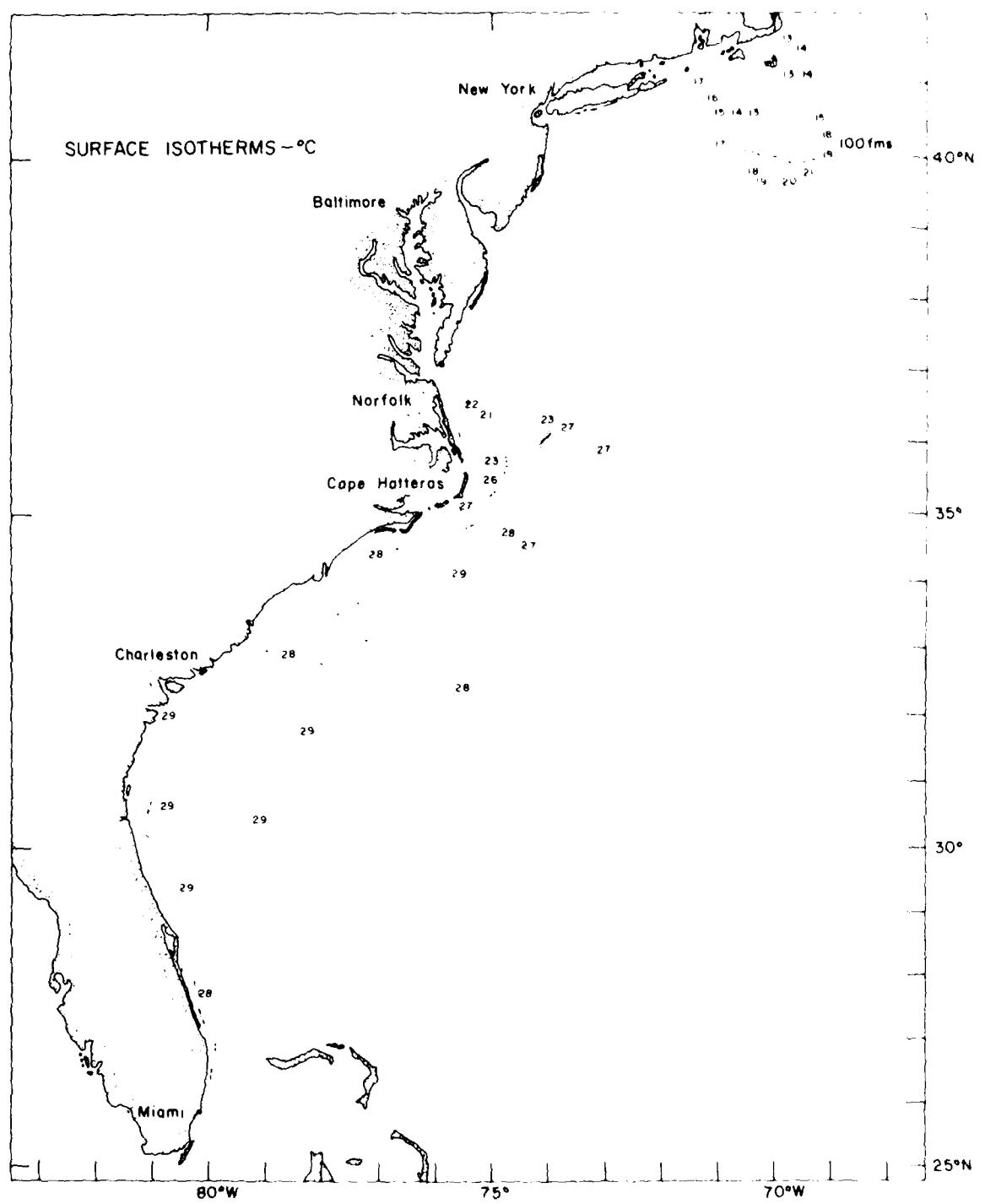


Figure 64. Monthly surface isotherm chart, 9-11, 16-18 September 1975

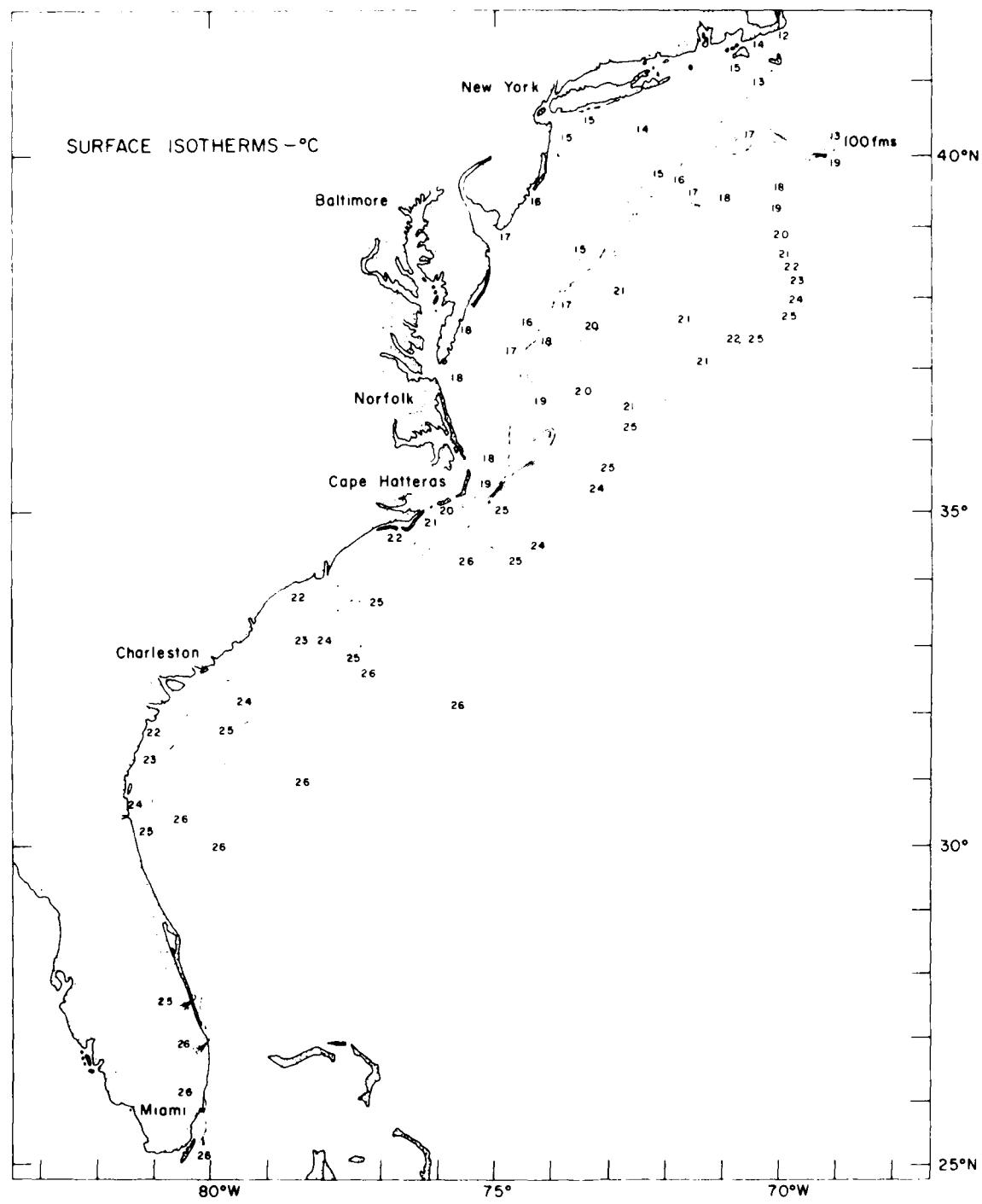


Figure 65 Monthly surface isotherm chart, 21-25 October 1975

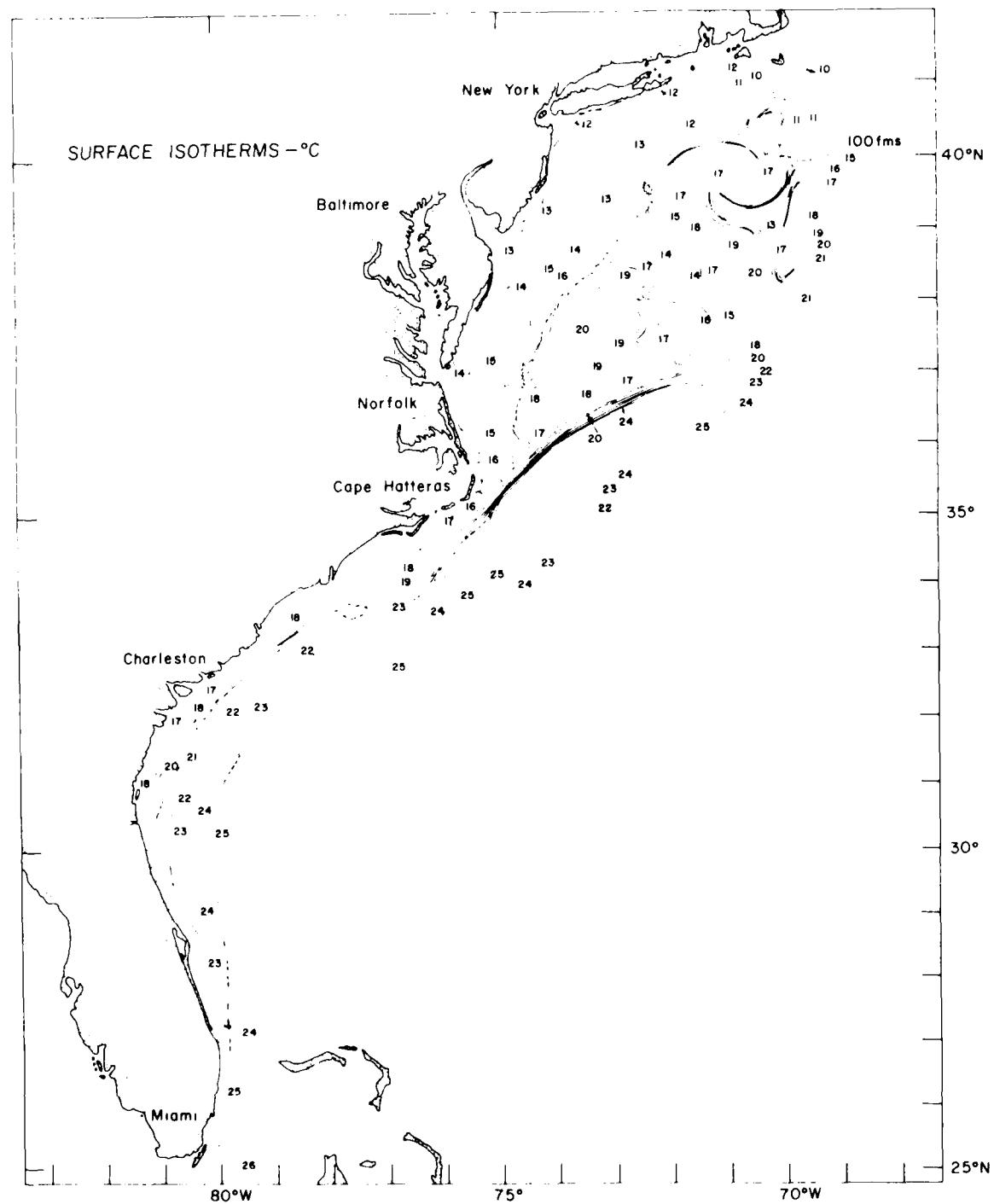


Figure 66. Monthly surface isotherm chart, 18-20 November 1975

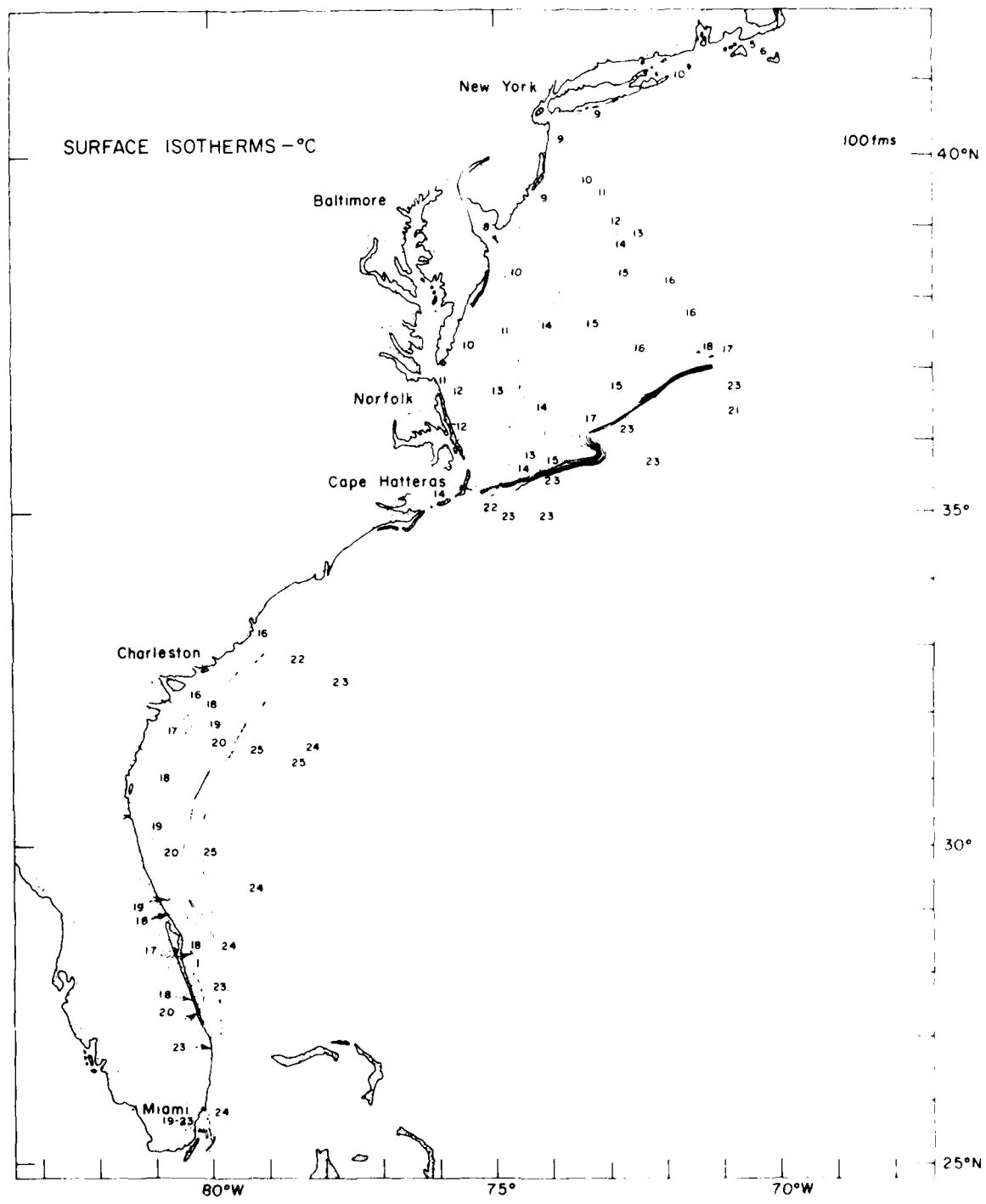


Figure 67. Monthly surface isotherm chart, 16, 17, 19, 22 December 1975

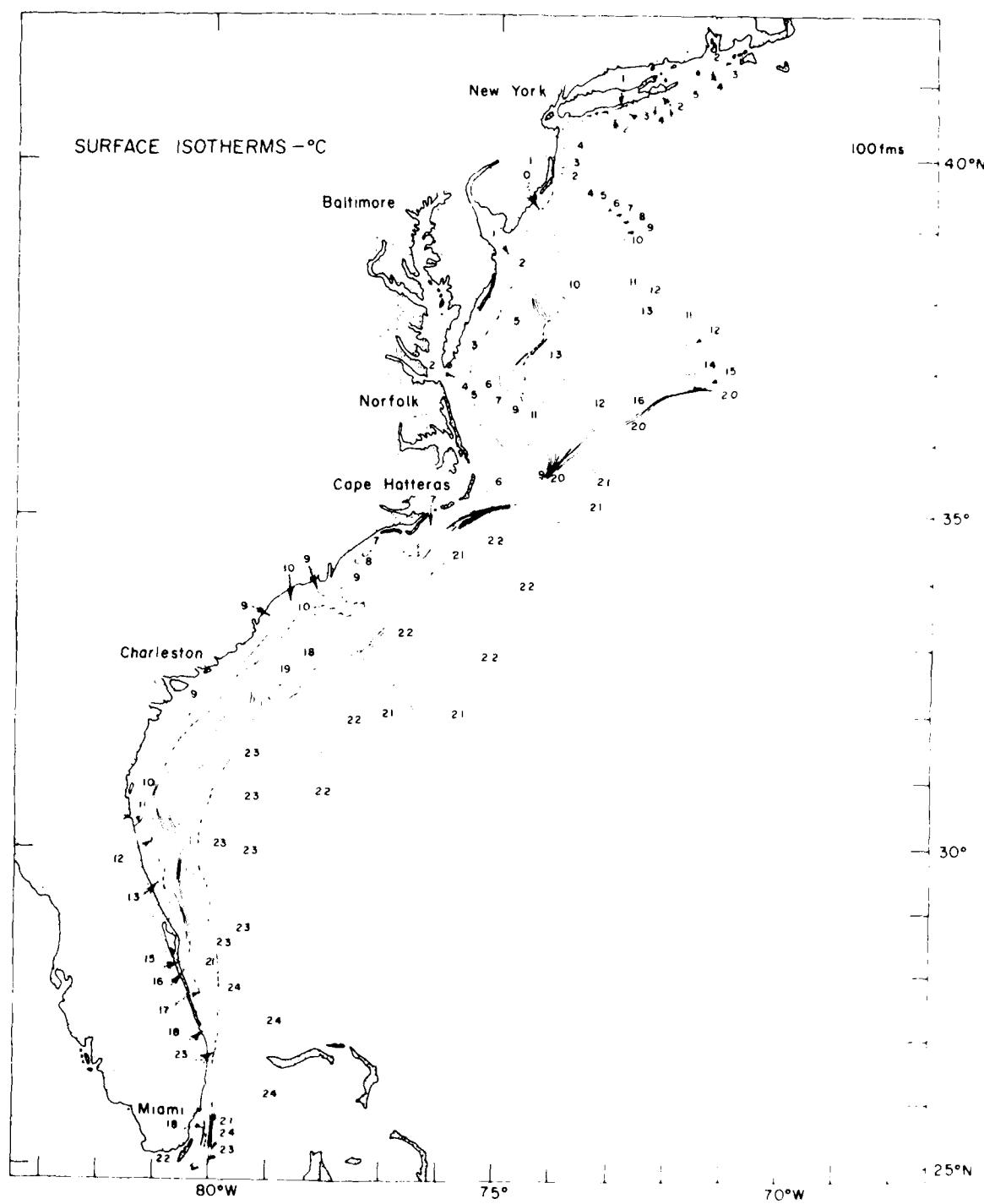


Figure 68. Monthly surface isotherm chart, 20, 21, 23, 24 January 1976

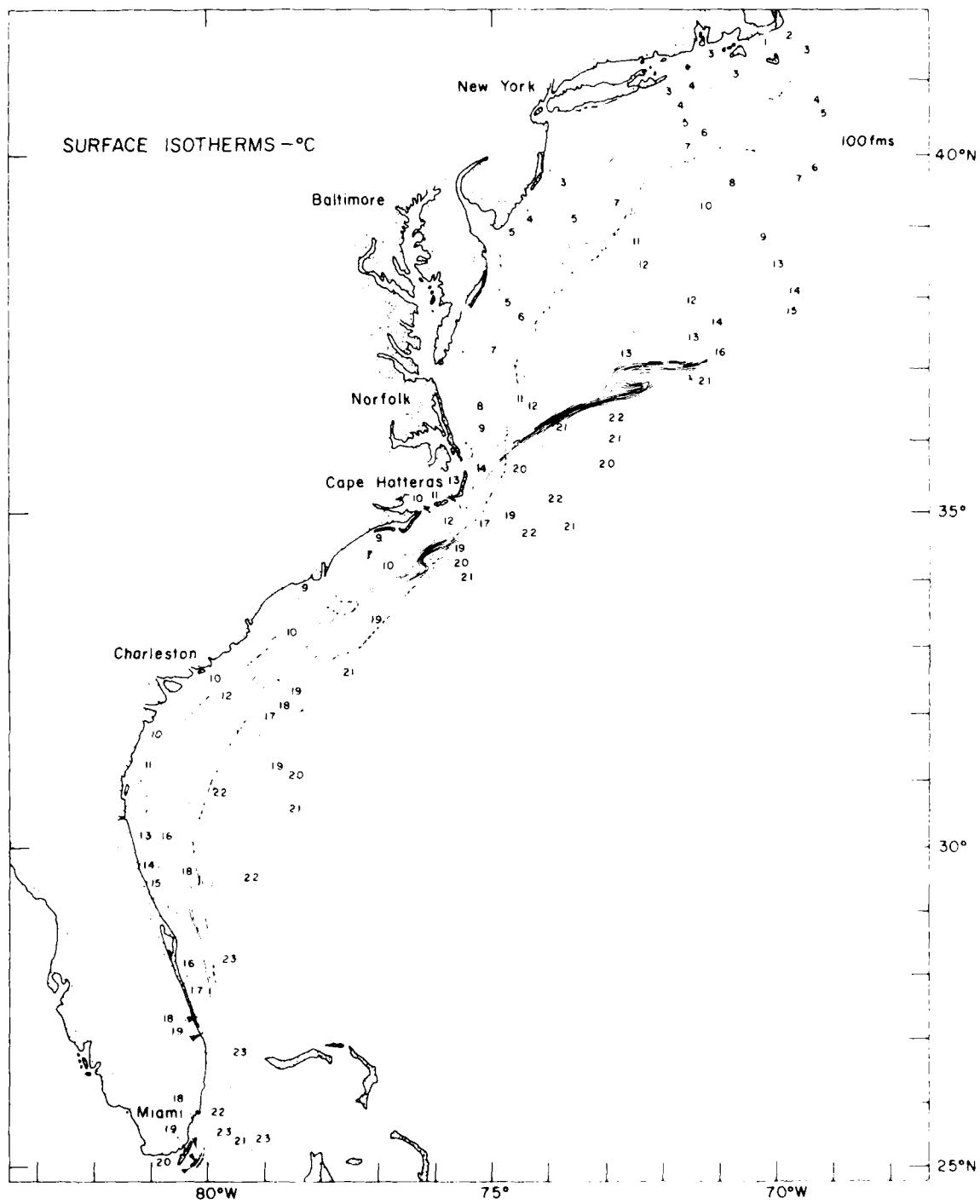


Figure 69. Monthly surface isotherm chart, 10-12, 20, 21, 23, 24 February 1976

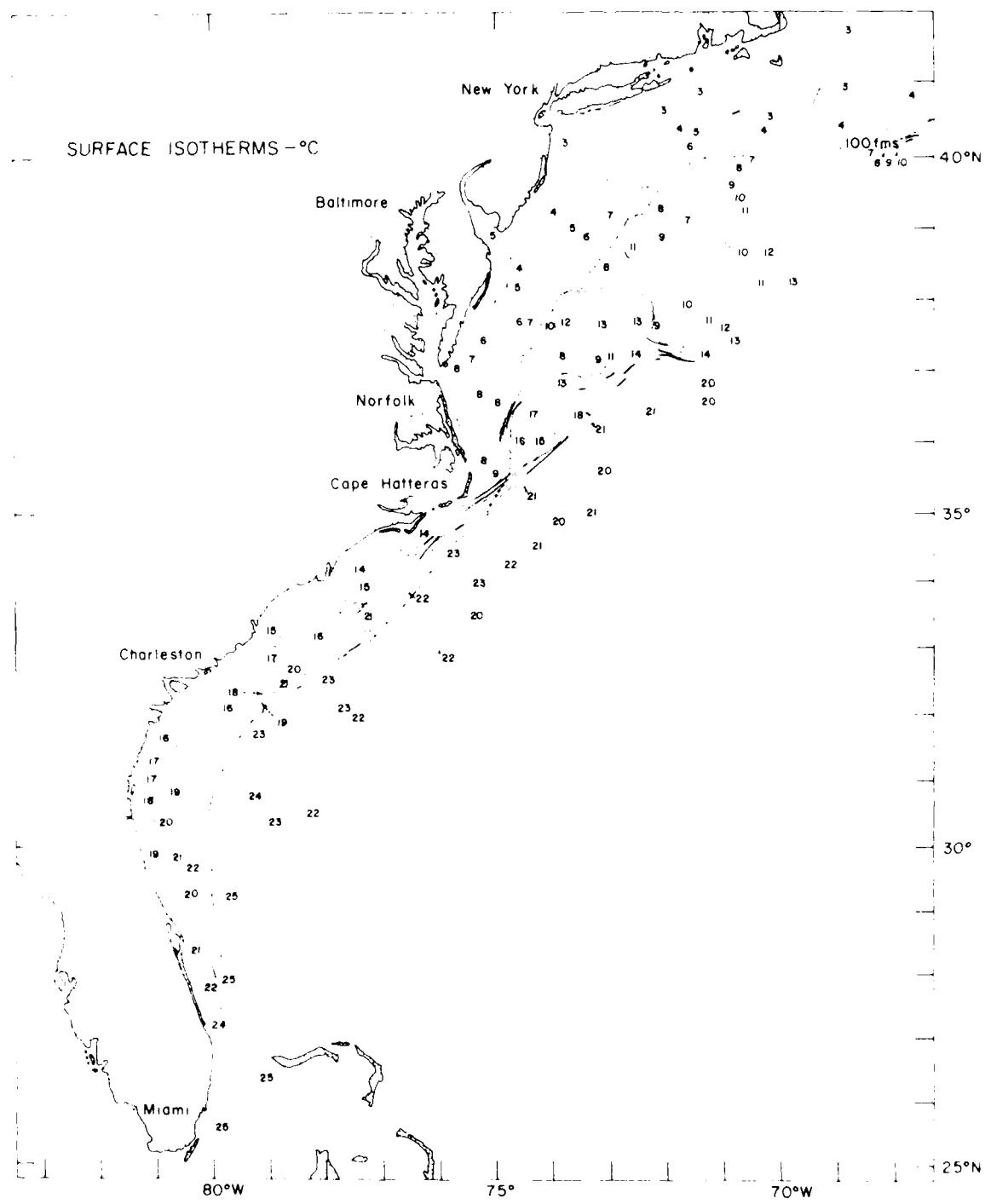


Figure 70. Monthly surface isotherm chart, 11, 12, 14, 23-25 March 1976

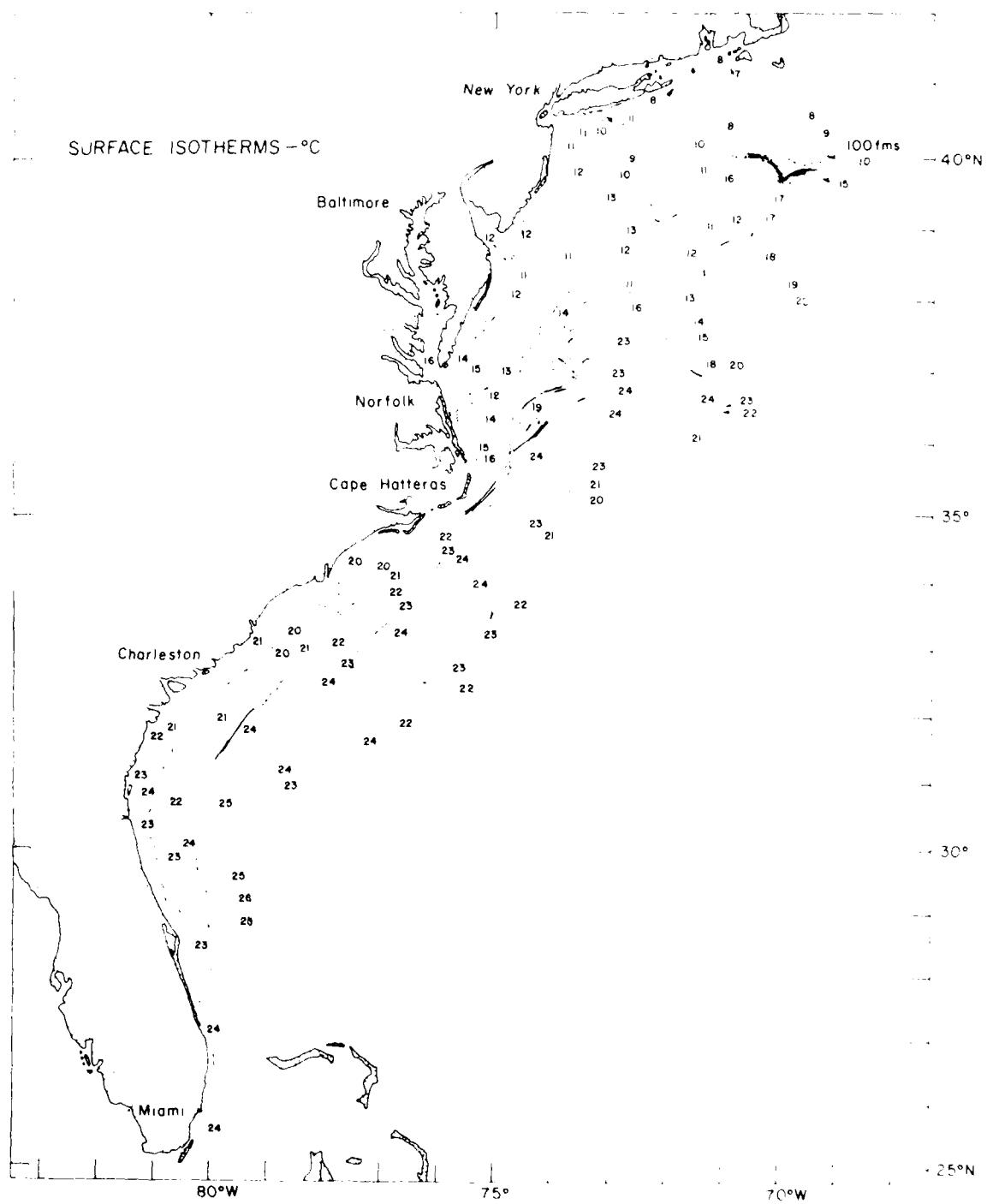


Figure 71. Monthly surface isotherm chart, 20-22 April 1976

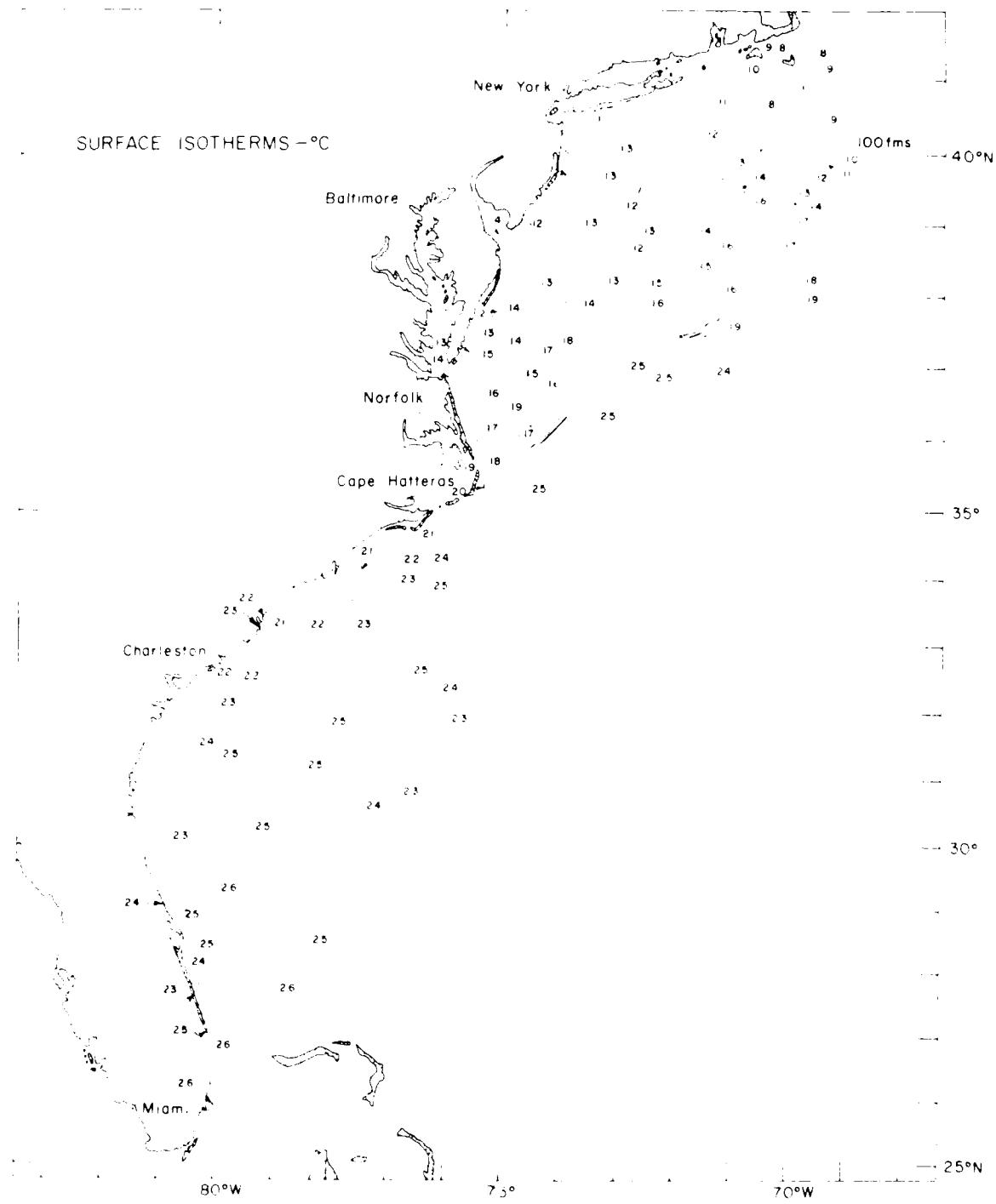


Figure 72. Monthly surface isotherm chart, 18-21 May 1976

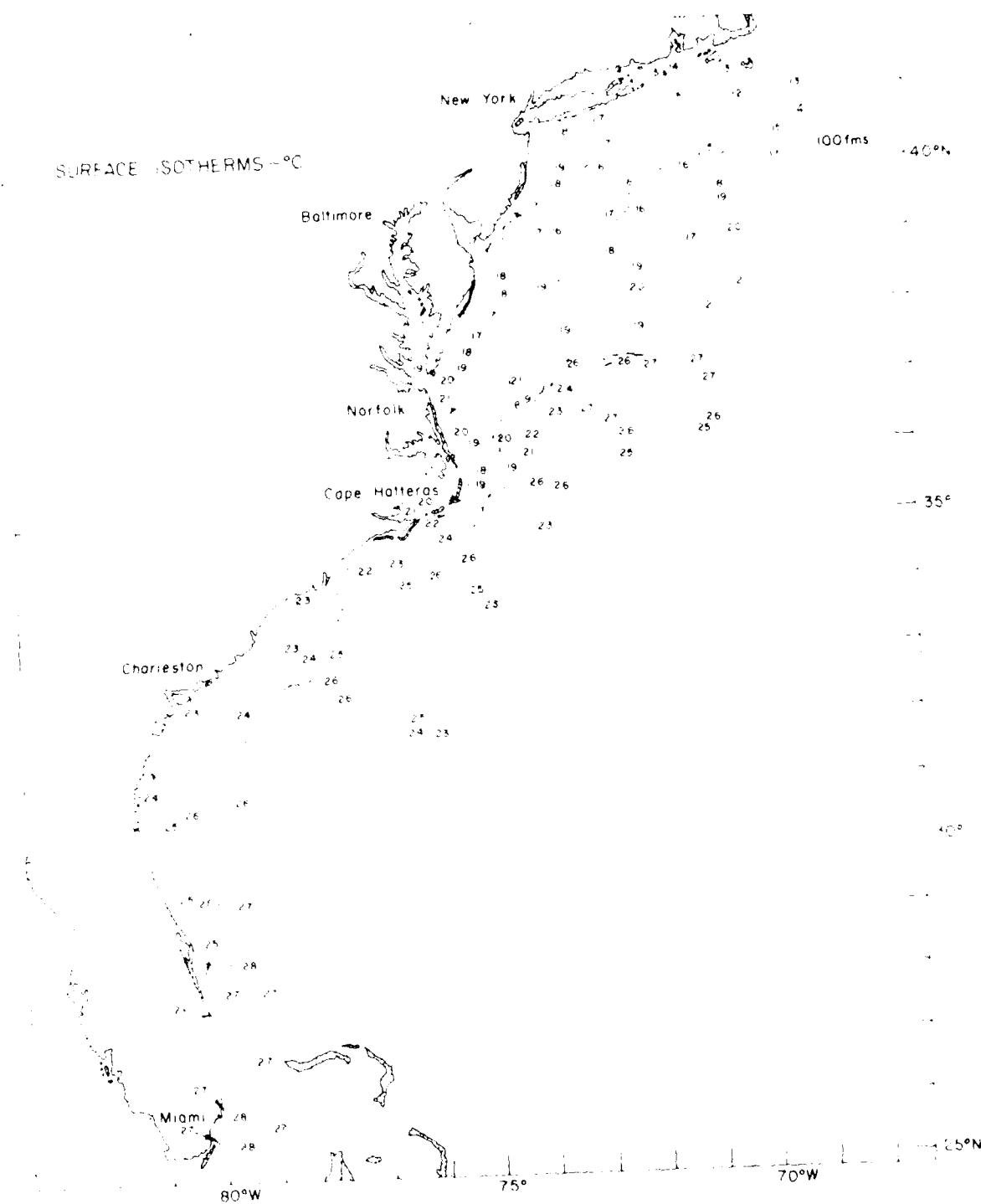


Figure 73

Monthly surface isotherm chart, 8-10 June 1976

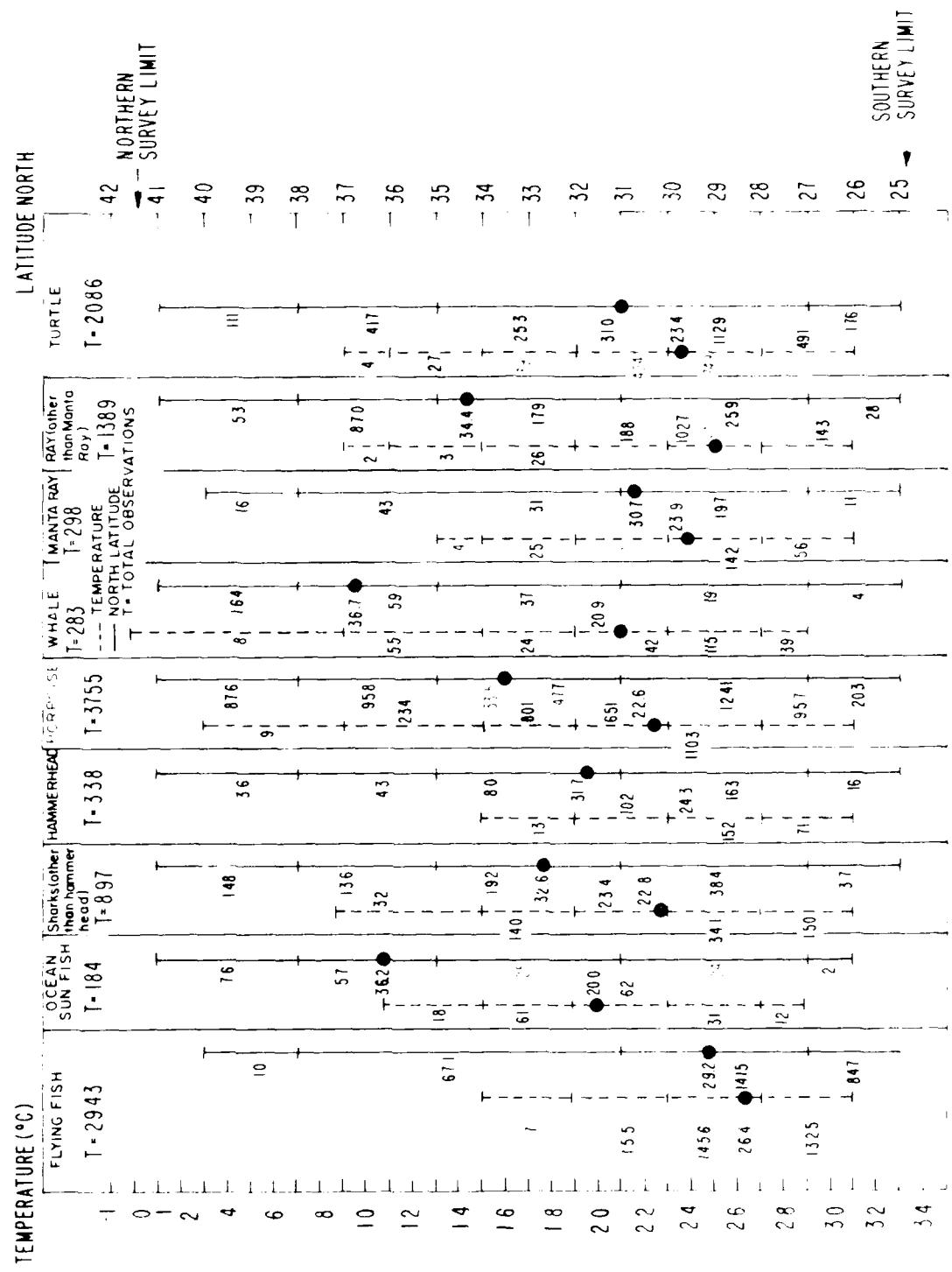


Figure 71. Graph of the plotted annual range and weighted mean temperature and latitude distribution of marine animal observations, July 1963-June 1976.

Codes Utilized

A complete description of the codes utilized in the tabulation of oceanographic station data can be found in National Oceanographic Data Center publication M-2, Processing Physical and Chemical Data from Oceanographic Stations, (Rev. August 1964, supplement issued May 1966.)

To facilitate use of the oceanographic station data listing, entry headings which are not self-explanatory are described below.

REFID	NOFC reference identity number
CONSEC	Consecutive station number
RODDEP (B)	Used recorded sound depth in meters
SHIP (B)	NOFC ship identity code
DATA USE	From 1 to 999, DSD data
AREA	NOFC ocean area code
COORD (A) (B)	Coordinates as required in WMO code 0.00 and elevation in meters according to WMO code 2.00
WAVE DESCRIPTIONS	
DIR	Direction of swell and waves in compass degrees according to WMO code 000
HGT	Height of swell and waves according to WMO code 100
PER	Frequency of swell and waves according to WMO code 100
SEAS (B)	Sea state according to WMO code 3.00
CLTR (B)	Water color according to four U. S. code. Transparency in meters as determined by Secchi disc
WINDDIR (B)	Direction from which wind is blowing in tens of degrees according to WMO code 000
WINDSPD (B)	Wind speed in knots
WINDDIR (B)	Wind force in Beaufort code
WEATHER (B)	Weather code. If preceded by letter X is according to WMO code 4501. A numeric two digit entry indicates weather according to WMO code 4677
INSTR	Instrument used for observation. "Nansen Cast" indicates station consists of Nansen cast data. "STD Recorder" indicates station consists of STD data or a mixture of STD and Nansen cast data
TRACE DIR (B)	"Trace" indicates U (UP), D (DOWN), and A (AVERAGED) used with STD casts, and specify that data were taken while hoisting or lowering or specify that the two traces were averaged
ELAPSE (B)	Time elapsed during raising or lowering of the STD recorder to tens of hours
ORIG (B)	Originator's reference number in two parts: year, station number or 3 characters in year of cast, serial number of trace, number year digits may sometimes only be 1 and in "Year" field, and station number
TEN SQ	Ten degree squares - modified Canadian square number
5 SQUARE	Five degree squares - modified Canadian system
2 SQUARE	Two degree squares - modified Canadian system
1 SQUARE	One degree squares - modified Canadian system
CASTNUM (B)	Number of cast on multi-cast stations (blank when messenger time is given)
TIME (B)	Time of release of messenger in hour and tenths for applicable observed levels. If midcast set occurs after past midnight, 24 hours are added to cast time of next day. Beginning time for STD is given at first obs depth
TYPE (B)	Type of record at depth indicated. "OBS" - observed values. For STD recorder - level of data read out "STD" - NOFC standard interpolated values. "ORG" - Standard or other depths carrying non NOFC interpolated values. "IPI" - Interpolated standard depth values used as obs for computational purposes. Note: When an observed level coincides with a STD depth level, both "STD" and "OBS" lines will appear
DEPTH	Depth of sample for standard levels in whole meters. Prefix "P" indicates the sonometrically determined depth (depth of unprotected thermometer). Subscript "Q" indicates that the value is marked doubtful by the originator. A value designated as implausible by NOFC is marked with a "P". Postscript "Z" indicates uncorrected and inaccurate "Wire-out" depths (high wire angle present)
TEMP (B)	Temperature in degrees celsius. For "Q" and "P" notation see depth field
SAL (B)	Salinity in parts per thousand. For "Q" and "P" notation see depth field
SIGMAD (B)	Seawater density anomaly to 2 decimal places. When depth, temp, or salinity is doubtful, a "Q" is suffixed. An asterisk indicates a decrease of 0.02 or more from the previous level
DYNDEPTH	Dynamic depth anomaly in dynamic meters to millimeters
SNDVEL (B)	Sound velocity in meters per second to decimeters according to Wilson's formula. (A standard depth pressure formula used for stations not beginning at the surface)
OXYG (B)	Oxygen in MLA to hundredths

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